THE

ELECTRICAL REVIEW.

VOL. XLVI. FEBRUARY 23, 1900. No. 1,161.

CONTENTS:

	PAGE
The Quality of Steam	297
Electric Traction Successes	298
Recent Papers on the Commutation of the Direct Current Dynamo (*illustrated*) (*concluded*)	299
The Electric Lighting of Tamworth (N.S.W.) (*illustrated*)	300
Municipalities as Electrical Traders	301
The Construction of Overhead Equipments.—I. (*illustrated*)	303
Reviews:—A History of Wireless Telegraphy	304
The Life Story of the late Sir Charles Tilston Bright	305
The Wiring of Houses for the Electric Light	305
Correspondence:—Our Position as Engineers	307
An Inventor's Grievance	307
An Electrolytic Centrifugal Process for the Production of Copper Tubes	307
Electrical Volunteers' "Send-off" Dinner	307
Business Notes	307
City Notes	318
Traffic Receipts	324
Stocks and Shares	324
Share List of Electrical Companies	325
Market Quotations	326
Institution of Electrical Engineers:—The Standardisation of Electrical Engineering Plant (*concluded*)	327
The Action of Electric Tramway Currents on Submarine Telegraph Cables and other Electric Circuits (*illustrated*)	328
On the Protection of Electric Power Transmissions from Lightning (*illustrated*) (*concluded*)	329
The L.C.C. and Electric Lighting Loans	331
The Resistance of Dynamo Brushes	332
Compulsory Works	333
Modern Machine Shop Economies	333
Electrostatic Measuring Instruments	334
Northern Society of Electrical Engineers' Dinner	334
New Patents	335
Abstracts of Published Specifications	335

THE

UNIVERSAL ELECTRICAL DIRECTORY

1900

Edition

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Telegraphic Address: "ARKREAY, LONDON." Code A B C.

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THE QUALITY OF STEAM.

THE *Engineer* raises a wail over a really very important consideration in steam practice, to wit, nothing less than the quality of the steam itself. The *Engineer's* opinion of good steam is a very fairly moderate and conservative opinion, for good steam is stated to be quite dry—nay, even superheated to about 10° and free from not only water, but also *dust and dirt*. We italicise these last two items because it is just at this point that the popular idea of steam and its qualities falls short of the actual fact. It is probably quite true to say that steam is often decidedly impure. When a boiler primes the dirt which it contains is carried over, in probably more than corresponding proportion, into the steam pipes and, no doubt, in spite of water separators, into the working cylinders of the steam engines. The dirt thus carried over is probably chiefly carbonate of lime, and its effect in cylinders must be most destructive and productive of friction. Those who, through thick and thin, uphold the practice of superheating, including, of course, the makers of the apparatus, tell us that though priming water may be passed limeladen into the superheater tubes, *these do not scale*. Now, if there is no scale formed in them, and there is now a considerable mass of evidence to this effect, it may well be asked what becomes of the lime salts that are carried out of the boiler. The *Engineer* will have it that they pass to the cylinders, and there is not much to be said against this contention.

With steam of the kind called good, our contemporary says an engine will run an hour for 13 lbs. of steam per horse-power. Yet engineers do not seek for such steam. They will investigate the quality of the fuel they use, they will examine oils for lubricating their engines, and even study the quality of the waste used for cleaning, but the steam is left alone. It is steam, and they have no more to say to it.

Yet the rust and lime that are carried by the steam out of a superheater are potent to cut the valve faces, and it is well known how wet steam will cut through valve spindles where it blows upon them by reason of the sand blast action of, not the water, as many suppose, but the fine gritty particles of lime. The idea of dry and dusty steam has not perhaps presented itself forcibly to engineers, because they see only the aqueous manifestation of steam outside their engines. Quite apart, however, from the quality of dustiness or otherwise, pure steam, or, as put by the *Engineer*, steam containing nothing but oxygen and hydrogen in water-forming proportions, may be wet. Wetness may be a quality quite distinct from boiler performance; it may be the result of long and exposed piping.

Wetness of steam is the greatest enemy of economy in working. It is pernicious because the interior surface of the cylinder is converted by the water into an alternate boiler and condenser. The cylinder has very little such power upon dry steam, nor does dry steam tend to place the interior of a cylinder in such a condition. The mutual

action and reaction of wet steam and cylinder surfaces is so serious that half the steam that enters a cylinder may be put out of sight of the indicator, and yet may appear in the exhaust pipe just as though no such cryptic action had taken place.

The *Engineer* recommends that the quality of steam should be maintained good. Thus the boilers should be fitted with scummers when the water is of the sort that throws up a floating "deposit," such as the well-known appearance in the gauge glass may be taken to indicate sufficiently. In view of the dearness of fuel, it is further recommended that steam should be dry. Superheating is not dealt with, but a steam drier is advised close to the engine, and it is suggested that something after the manner of a surface condenser might advantageously be employed, with the difference that the tubes would be surrounded by hot oil, kept hot by circulation through coils in the boiler flues. This system has already been proposed by Messrs. B. H. Thwaite and W. H. Booth, and forms the subject of a patent; but the fluid preferred is glycerine, the boiling point of which is very high, and the specific gravity and heat-carrying capacity of which is much above that of oil. The advantage of the system is, of course, as pointed out by the *Engineer*, that oil and glycerine can be circulated under atmospheric pressure, and a small oil pump placed in circuit is sufficient to maintain a continuous circulation with a minimum of power. The glycerine or oil system can be applied to the heating of ordinary steam jackets in place of using steam in them, and it can be applied also to the jacketing of already non-jacketed cylinders by means of thin sheet slabs or by coils of thin pipe wound about the cylinder or even by coils placed on steam pipes. Indeed, the system is a very flexible one. But apart from such undoubted aids to economy, the question of steam quality, so far as regards the presence of solid matter, is one that requires to be attacked at its origin. This can only be done in the selection of a suitable water for the boiler, or its proper treatment by softening, or better still, by such a system of water conservation by means of surface condensation as will provide a constant supply of water, pure so far as our purpose is concerned. We are of opinion that the softening of some waters may be very simply and easily carried out, but that others are so intractable as to render any process either impossible or so difficult that the removal of the oil from the water delivered by the air pump is quite a small matter in comparison. Oil can be removed from the condensed water, but scale-forming matter cannot always be removed from water before it enters the boiler. The use of certain superheaters with water-tube boilers has been found to add greatly to the boiler output, for the boilers have been so forced as to prime heavily. It is clear that such heavy priming must have its effect in dusty steam, and the practice is not one to be recommended in every case.

The Serpollet boiler, fed with just as much water as is wanted to produce the next cylinder full of steam, is said not to become furred up by the process. This is confirmatory of the non-adhesiveness of the lime salts, and points obviously to more or less dusty steam. As regards the non-adhesion of lime salts to boiler plate, there is much to show that only those particles adhere to the metal that are left on it by the water leaving the plate as steam. Lime sulphate is such a salt, and, apart from its natural characteristics, the way in which a sulphate scale is formed accounts for its adhesiveness, the molecules separated out in a nascent state being probably just in a condition to adhere to the first presented surface.

ELECTRIC TRACTION SUCCESSES.

Those who have ever doubted what a great boon electrical working would confer upon tramway authorities, may find ample demonstration at the present time in various parts of the country, that the prophecies of electric traction advocates have not been exaggerated, at any rate, in respect of more economical operation, increased traffic, and therefore, of course, larger net profits. The municipal authorities of Leeds can find no praise too high for electrical haulage on the trolley method, and they are taking care to nourish the golden goose by a policy of wide extensions. At Glasgow, Dover, and other places as well, the advantages in practice have been fully proved to be quite up to any promises held out before the experiment was entered upon. But above and beyond all these there are two towns which might, to all intents and purposes, be regarded as the real pioneers of the trolley system in these islands—we refer to Bristol and Dublin.

So enterprising have been the companies operating the systems in these two places—the Bristol Tramways and Carriage Company, and the Dublin United Tramways Company—so great were the difficulties faced when, through municipal ignorance, the overhead trolley was in glorious disrepute, and so ready have they been to allow their systems to become happy hunting grounds and useful object lessons for the education of municipalities throughout the country, that it is with considerable satisfaction that we record their greater prosperity. For the year 1899 both companies are enabled to show an increase of 1 per cent. in dividend, this being attributable to the change over to electric power. As a matter of fact, in neither town has the work of conversion yet been quite completed, and on many miles of track electric cars have been running for considerably less than a year. When the Ringsend power station of the Dublin Company gets into full working order and furnishes energy for the complete system, thereby shutting down the present smaller stations, the economies and the receipts should be far greater than they are now. The promise for the future is very bright.

Mr. Murphy told his shareholders at Dublin the other day that the accounts for the year showed an increase of £5,561 in gross receipts, but the net profits were £10,691 more than in the corresponding period, from which it was apparent that not only had they increased the traffic receipts by more than £5,000, but that it cost them £5,000 less to earn the increased receipts. "That," he remarked "was the secret of the success of the electric system — namely, increased receipts and diminished expenses."

With regard to the Bristol Company, very much the same state of things has been experienced, and when the new power station there is completed, and the entire system has changed over to electrical working—which is expected to take place during the summer months of this year—the shareholders should be in a very enviable position.

There is one unfortunate thought in connection with this matter. We who live in London are apt to grumble with our lines. So far as street transit is concerned, the lines have certainly not fallen unto us in pleasant places. We are now rejoicing in the enjoyment by Dublin, Bristol, Leeds, Glasgow (and a string of etceteras) of the advantages of electric traction, while London jolts along in a two-horse car at something more than a mile an hour. Spring Gardens, kites, clothes lines, and ignorance, are responsible.

Electricity Supply Works.

With this issue we are able to lay before our readers a table giving the principal features of the alternating current electricity supply works in the United Kingdom. The number of stations is continually increasing, and therefore we have thought that it would be more convenient for reference to publish alternating and continuous in separate sheets. The continuous current list will be published with our next issue. Had we not adopted this course a record might have been established for inconvenience both in regard to size and by printing on both sides. In accordance with our usual custom, we have endeavoured to give only the main features of interest and not to crowd in a forest of unwieldy detail, making reference a matter of extreme difficulty. We take this opportunity of expressing our gratitude to engineers who have helped to make our details complete by furnishing information regarding their respective works.

RECENT PAPERS ON THE COMMUTATION OF THE DIRECT CURRENT DYNAMO.

Thorburn Reid.—"Sparking, its Cause and Effects": read at the meeting of the American Institute of Electrical Engineers, December 15th, 1897.

T. Fischer Hinnen.—"Observations of Methods of avoiding Sparking in Continuous Current Machines." *Elektrotechnische Zeitschrift*, December 30th, 1897.

Eustace Thomas.—"Sparking in Dynamos." The *Electrician*, February 18th, 1898.

H. N. Allen.—"Sparkless Raversal in Dynamos." *Journal of the Institution of Electrical Engineers*, April, 1888.

W. H. Everett and A. H. Peake.—"Experiments on Commutation in Dynamos and Motors." The *Electrician*, April 22nd, 1898.

W. H. Everett and A. H. Peake.—"The Effect of Commutation on the Field of Dynamos and Motors." The *Electrician*, December 30th, 1898.

E. Arnold.— *Elektrotechnische Zeitschrift.*
G. Kapp.— *Elecktrotechnische Zeitschrift*, 1899.

(*Concluded from page* 213.)

§ 19. The analysis of the case where the brush covers several commutator segments is excessively complicated, though the expressions assume forms similar to those of § 14, and can be dealt with arithmetically by similar though more laborious calculations. Neither from the character of the formulæ, nor from general considerations, can one obtain any expectation of an improvement in the collection by the use of thick brushes. The field required for commutation has been shown in § 9 to be practically unaffected by thickening the brush, while it cannot be easier to provide the exact commutation field required over the area of a thick brush than of a thin one.*

§ 20. So far this essay has dealt with two main points, viz, the character of the field required for sparkless commutation, and modes of mitigating the effect of error in the adjustment of this field. The point with which dynamo designers are principally concerned, the method of producing the field required, is untouched. Although this does not admit of exact analysis to nearly the same extent as those already discussed, some notice of it seems necessary.

The commutation field has been produced in the following ways:—

1. By the stray field between the pole tips.
2. By small electro-magnets opposite the commutation points, or by polar extensions from the field magnets, excited in either case in series with the armature.
3. By the methods of Messrs. Sayers, Ryan, and Mordey, respectively.

Before dealing further with these methods the object in view may be laid down. The designer aims at producing a machine which will transform mechanical into electrical energy, or *vice versâ*, at a given rate and efficiency with the smallest expenditure of labour and material. The energy

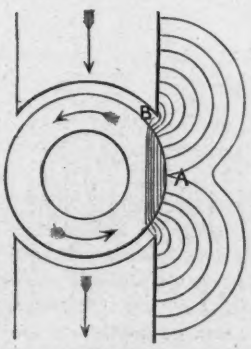


Fig. 15.

transformed is a product of the current and the electromotive force. The strength of current that can be taken from the machine is principally limited by the condition of sparkless commutation, and is determined to that extent by the provision of a suitable commutating field. The electromotive force is determined by the flux through the armature from the field magnets, and an important factor in this quantity is the air gap between the magnet poles and the armature, which should be kept as small as possible. If this gap is very small the stray field is reduced to such an extent that sparkless commutation by its means can only be effected for small currents. If the gap is large so that the stray field is ample, an excessive amount of power is expended in field excitation to obtain the required E.M.F.

§ 21. *Commutation by the Stray Field between the Pole Tips.*—This mode of commutation has been the one in view in all the diagrams and arguments in this paper. Fig. 15 is a diagram of the stray field of a dynamo whose armature is revolving in the direction of the curved arrows. Commutation of any coil is effected in the space between A and B in which the flux in the coil due to the field magnets is continually decreasing as it cuts the lines of the stray field entering the armature in that space. This part of the stray field has its maximum density near B, and zero density near A; and for sparkless commutation it must be possible to find positions between those two points of suitable density for commutating every load within the machine's capacity, and the density of the field near B should be sufficient to commutate the emergency load. The production of this stray field involves a comparatively large polar air gap, and a largely increased waste of power in the magnets; and the object of recent designs has been to obtain commutation without employing the stray field.

At this point we may refer to the article by Mr. Kapp in the *Electro. Zeitschrift*, referred to in the heading of this paper. Mr. Kapp desired, using elementary reasoning, to place on a logical basis a certain rule of thumb commonly used by dynamo designers to guide them in the provision of a sufficient commutation field, which has been accepted as the result of experience.

Mr. Kapp obtained the following two rules for sparkless commutation:—

Rule A.—B_α must be greater than $C_0 \frac{\Delta}{n}$.

Rule B.—$C_1 \frac{\delta}{R} \cdot \frac{S}{1+n}$ must be greater than unity;

where B_α is the density of the flux under the (in a dynamo, trailing) pole tip,
Δ is the mean linear stream density over the armature surface,
n is the number of commutator bars covered by the brush,
δ is the polar air space,
R is the radius of the armature,
S is the total number of commutator bars,
C_0 C_1 are constants for any member of one family of machines of different sizes and the same type; values of C_0 and C_1, obtained from observation of actual dynamos, are given in Mr. Kapp's article for several different classes of machines.

Rule A states in effect that the greatest density of the commutation field, which is close to, or under, the pole tip, must exceed a quantity which is proportional to the density of the current on the armature surface, and inversely proportional to the number of the commutator bars under the brush.

Rule B states that the ratio of the polar air space to the linear dimensions of the machines must exceed a quantity which is proportional to the thickness of the brush plus one commutator bar, and inversely proportional to the circumference of the commutator. Rule A is intended to secure a field of sufficient density, Rule B to secure a field of suitable distribution.

With great diffidence the present writer points out that neither of these rules is in accordance with the conclusions arrived at in this essay. In § 9 it was concluded that the density of the field required for commutation is not affected by changing the number of commutator sections, so that the quantity, n, would have no place in rule A. In § 18 it was argued that the reason why commutation is easier with a commutator of many segments depends, not on any difference in the distribution of the commutation field, but upon the greater effect in the production of sparking that is caused by

* In a recent letter addressed to this journal, Mr. Rew dissented from this view of the value of thick brushes. Such evidence on the point, however, as the writer himself has been able to obtain, supports his conclusion that thick brushes do not assist a weak commutation field.

errors in that field when the number of commutator bars is reduced, and there is no obvious reason why there should be greater average error through the extended field of a thick brush, than the narrow field of a thin brush.

§ 22. *Commutation by Auxiliary Electro-magnets or Polar Extensions.* — Both of these plans were proposed by Mr. Swinburne many years ago and seem to meet the conditions of the problem more exactly than any other plan. They have, however, for some reason not come into general use, but why the writer does not know. It may be that with the use of surface winding the current output of a machine has been determined rather by the heating of the armature bars than by the sparking limit, and that commutation by the stray field has been sufficient. At the same time the horse-shoe type of machine does not lend itself readily to the use of auxiliary commutating magnets. Now that slot winding has become general, and armature bars are free from heating by eddy currents, the output is limited by the sparking, and devices of this kind may come into use. The more general use, too, of symmetrically designed field magnet frames may make a difference. Mr. Fischer Hinnen, in the paper referred to above, described a machine of the Manchester type with auxiliary commutation poles which was extremely successful. Designed to give 400 amperes at 5 volts, it could be loaded to 1,200 amperes without it being possible to say whether the machine was doing work or not.

§ 23.—*Sayers' method* consists in using long armature connections between the armature coils and the commutator bars, which are formed into coils laid round the ribs of the slotted armature. The commutating flux is introduced into these coils and not into the armature coil itself

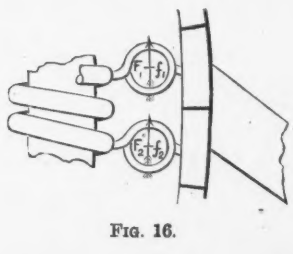


Fig. 16.

which is being commutated. Fig. 16 is a diagram of the arrangement. The differential equation which determines the value of the excess current γ in this case is similar in form to that obtained in § 14, and the conclusions arrived at there as to the effect of brush resistance, and armature connection resistance, hold for this arrangement also. If F_1 F_2 are the rates of change of flux in the armature connection coils necessary for perfect commutation, l' the inductance of each coil, f_1 f_2 the errors in F_1 F_2 respectively, other letters retaining their old significance, we have

$$-(F_1 - F_2) - (L + 2L')\frac{dc}{dt} = (R + 2\rho)C$$

$$f_1 - f_2 - (l + 2L')\frac{dc}{dt} = (R + 2\rho + r_1 + r_2)\gamma.$$

In these equations it has been supposed for simplicity that no commutation field at all acts in the commutated armature coil, and that $n = 1$. This arrangement has the advantage that the armature connection coils are under the pole during commutation, and no stray field at all is required. The flux in each of the two connection coils is rapidly increasing during commutation, but the flux in one acts in an opposite sense to that in the other, and the nett difference of the rates of change of the two is very much less than the rate of change of either of them. Consequently commutation may be carried on in the dense sub-polar field.

§ 24.—*Mordey's method* of commutation was described in a paper before the Institution of Electrical Engineers in 1898. In this arrangement each armature section consists of two coils placed some distance apart on the armature, and connected in series with one another between two consecutive commutator bars. Commutation is effected when one coil is under one pole, and the other under the other pole. The change of flux taking place in the leading coil of the pair is in the desired direction for commutation, but is too rapid. That taking place in the trailing coil is in a direction opposite to that in the leader, and brings the nett rate of change in the system to a suitable amount. Thus as in Sayers' system, the sub-polar field is employed for commutation, no stray field is required, and the sub-polar air space may be reduced to any amount consistent with mechanical conditions. Both plans depend upon a differential arrangement to obtain suitable commutating action from coils in which the change of flux is too rapid.

§ 25.—*Ryan's method* is to attach a large coil to the field magnets, laid round the armature but not revolving with it, having its axis perpendicular to that of the main magnet field. This coil carries a current in series with the armature producing a field in a direction opposite to that of the armature itself. Collection is made at points half way between the pole tips, so that the field magnet provides no commutation field. A cross field at right angles to the main magnet field is the difference between the fields due to the armature current and the large commutating coil which are in opposite directions, and this performs the commutation.

W. A. P.

THE ELECTRIC LIGHTING OF TAMWORTH (N.S.W.)

(From our Sydney Correspondent.)

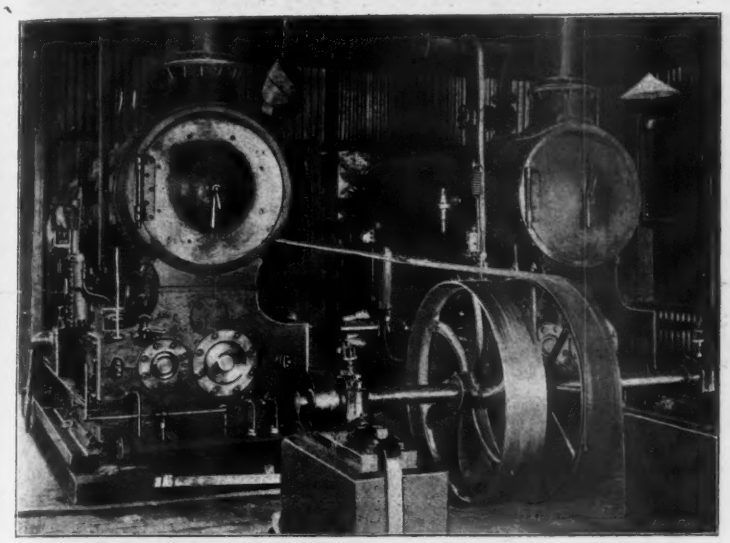
The town of Tamworth, in the colony of New South Wales, situated about 268 miles north of Sydney, is generally

Storage Reservoir.—Tamworth.

Storage Reservoir.—Tamworth.

credited with being the first in Australia to adopt electricity for street lighting. The plant, which is still only on a small

scale, was first operated in 1888, and has been running successfully ever since, though without any extension of plant and very little extension of business. The plant consists of two 12-N.H P. compound Fowler engines of semi-fixed type,



SEMI FIXED ENGINES.—TAMWORTH.

non-condensing, having the cylinders, &c., placed beneath the boilers. The boilers, which are multitubular, are worked at a pressure of 120 lbs., and steam piping arranged that either engine can be worked by either boiler. Wood is principally used for fuel, with some coal, the fire-boxes taking 3-foot logs. Expansion valves controlled by a Hartnell governor are fitted to both high and low pressure cylinders. Engines run at 150 revolutions and drive a countershaft from which the dynamos are driven, the countershaft having a coupling in the centre. There are two Crompton dynamos, each giving 90 amperes at 230 volts when running at a speed of 750 revolutions.

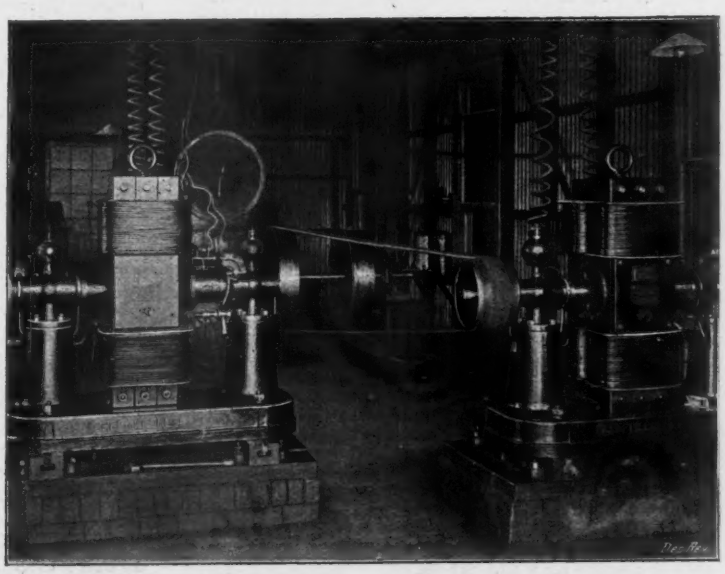
The plant is used almost entirely for street lighting, overhead wires being used throughout without suspension wires. For lighting 11 miles of streets, covering an area of about 8 square miles, four arc lamps and 260 incandescents of 16 C.P. are used. The existing gas lamp-posts have been utilised, the lamps being fastened to the central gas pipe by a gun-metal clip insulated from the pipe by a fibre ring. Two or three lamps are placed in each lantern, according to their position; the lanterns nearest the station and in important streets have three 75-volt lamps in series, as the distance increases two 110-volt lamps are used, and finally two 105-volt lamps; the maximum distance of any lamp from the station being nearly a mile and a quarter. The four arc lamps are used for lighting Peel Street, the principal thoroughfare, at the intersections of the cross streets. The private lighting is very small, consisting of about 40 incandescents and six arcs, with temporary lighting for special occasions.

The average output of units per annum is approximately 28,000, the maximum load observed 28 KW., and the cost of production comes out at 5·47d. per unit, made up as follows: —Fuel, 0·48d.; oil, waste, &c., 0·26d.; salaries, wages, and insurance, 2·5d.; repairs and maintenance of arc and incandescent lamps, 1·0d.; interest on capital expenditure, 1·23d. This expenditure is met by a rate of 5d. in the £, bringing in £700 per annum.

There is a proposal on foot for getting additional power for private supply from the new water supply scheme. This supply of water is impounded on the Moonbi range of mountains, about 12 miles from Tamworth, at an elevation of about 900 feet above the lower portions of the town. The storage dam has a capacity of 50 million gallons, and the estimated power available is put down at 28 H.P. at the turbines, with an average flow of 200 gallons per minute. The delivery of water with a pipe line 7¼ inches diameter is calculated at 23,500 gallons per hour with full flow, the delivery in practice to be regulated to 12,080, and pressure 205 lbs. to the square inch. The turbines will run continuously, charging accumulators at a pressure of 600 volts, the distribution being on the three-wire system, with 440 volts between outers, the generating station being situated about 1½ miles from the town. It is estimated that 93,125 units will be available per annum, of which 30,000 will be required for the public lighting, the remainder being sold by meter for private lighting and power purposes. The estimated cost of the extensions is put down at £5,559, the annual working expenses at £963, and the revenue at £1,586, made up of a lighting rate of 3d. in the £, and a meter rate of 8d. per unit.

MUNICIPALITIES AS ELECTRICAL TRADERS.

THE question of municipal trading in its bearing upon the electrical industries promises to demand a great deal of attention during the coming months. It will be remembered that last year many applications for powers to carry on the manufacture and supply of electrical apparatus, fittings, &c., were lodged by municipal authorities all over the country, but it was with considerable satisfaction that we, and all who have the best interests of private enterprise, and therefore national industry at heart, heard the announcement that these proposals were not to be allowed, and they were rejected in a



CROMPTON GENERATORS.—TAMWORTH.

batch. But municipal representatives, though claiming to be able to rejoice in an immunity from the shibboleths of party politics, are loud, and almost angry, in their clamourings for municipal trading, the tendency of which, to our way of thinking, is in the direction of an objectionable form of socialistic dealing. They appear to be pressing the matter, and a decision had bettter be given once and for all. We are not opposed to municipalisation, so long as it is carried out within certain limits. It is pretty generally conceded, we think, that water and lighting undertakings lend themselves to municipal treatment, but even then they are likely to produce certain undesirable monopolistic effects. We should not care to be called upon to make a comparison between the municipal installations in this country and the company plants, for as recent events have shown, both have their faults and pass through unhappy experiences to the consequent disadvantage of the public. But for a municipality to engage in trading—in manufacturing, buying, and selling—when such trading brings it into direct conflict with the interests of manufacturing concerns, which have done more than anything else to bring our country to the commercial position that it has held for years, would be one of the most unwise, as it would be unjust, developments that have occurred for many years. Its unwisdom would be found in the lack of encouragement that would be afforded to private enterprise under the new *régime;* it would be fraught with the greatest dangers to developments in the way of invention, design, and manufacturing; it would command for the furtherance or realisation of an impossible communistic notion the energy and genius of men who would otherwise have been engaged with a greater zest and with better promise of personal success in strengthening our position as a manufacturing and engineering nation. We believe that many of those who are hankering after municipal trading are men whose trend is ultra-communistic, who would rub their hands with glee could they but place a canker at the root of capital and undermine its operations, bringing about its downfall, to the benefit, as they mistakenly suppose, of the worker.

Municipal trading, outside the reasonable limit of lighting, water supply, and, in some cases, local transport, would, if allowed in its mildest form, prepare the way for developments upon the same socialistic lines, which would ultimately lead to nobody knows where. The desire for municipal trading is one of the many unfortunate results of our present local governing system, which allows men of extremely limited knowledge and with very narrow views to tamper with matters which seriously affect great and well established principles as well as national industrial interests, and this merely that local government may be conducted upon the lines which they suppose are the best. Our object in writing this article is not to pass our strictures generally upon municipal *personnel*, for we have met among them some men whose views have been comprehensive, and who have had a thought for the future and for something beyond their own little tin god of a municipality—men whose actions are uncontrolled by party cries where serious questions are to be wrestled with. It is only by this better class of municipal representatives exercising their influence in a straight commonsense way that they can prevent the municipal trading party from becoming the ascendant. We believe that the time is coming when the little-minded policy of local self-interest will be trampled under foot by the larger ideas of commercial and imperial progress. That policy threatens industry purely for the sake of making a few extra pounds per annum to reduce the local rates (perhaps), and for the mutual glorification of town councillors of the "See what I've done!" stamp.

We can only hope that when the proposals come before Parliament again, that august assembly will treat them with the consideration which they deserve, and flout the idea of municipal trading once and for all.

It may be remembered that last year the leader of the House of Commons promised the appointment of a Joint Committee of both Houses to consider the whole subject of municipal trading, but at the close of the last Session this promise remained unfulfilled. The Government have, however, given a definite assurance that the Committee shall be appointed early this Session. Although more momentous questions have been occupying a great deal of attention in Parliament of late, we think that municipal trading is a matter of so much consequence that it should not be overlooked, and we trust that the appointment of the Committee will be sandwiched in at the earliest convenient moment.* In the meanwhile, however, it may furnish a certain amount of consolation if we say that the Liberty and Property Defence League is collecting suitable evidence to be tendered when the opportunity arises.

To leave generalisation and come to details. The remarkable Bill promoted by the West Ham Town Council we have already dwelt upon at length.† Our attention has now been directed to one to be introduced by the Halifax Corporation, one of whose clauses is of great importance to the electrical traders of the town. Mr. R. F. Sunderland, as a representative of the threatened class, placed his views before the people of Halifax in the local press. We quote as follows from one of his letters in which he intimates the grounds upon which the objections of the members of the electrical trade were based:—

The Bill reads in part 8, Section 91, thus:—

> The Corporation seek powers to provide, sell, let for hire, and fix, set up, alter, repair and remove, but shall not manufacture lamps, meters, electric lines, fittings, apparatus, and things for lighting and motive power, and for all other purposes for which electrical energy can or may be used, or otherwise necessary or proper for the supply, distribution, consumption, or use of electrical energy, and may provide all materials and do all works necessary or proper in that behalf, and may require and take such remuneration in money or such rents and charges for and make such terms and conditions with respect to the sale, letting, and fixing, setting up, altering, repairing, or removing of such lamps, meters, electric lines, fittings, apparatus, and things as aforesaid, and for securing (both as regards the consumer and third parties) their safety and return to the Corporation as the Corporation may think fit, or as may be agreed upon between them and the person to or for whom the same are sold, supplied, let, fixed, set up, altered, repaired, or removed.

In fact, as Mr. Sunderland says, in other words, to carry on the business of electrical contractors for the sale and erection of all internal wiring and fittings, thus creating a powerful opposition to the very people who have made and are still making the Halifax electricity works a successful venture.

The electrical contractors are the men who

> by keen canvassing and the healthy competition existing amongst them, excite that demand for the Corporation's commodity, namely, electrical energy, which could not by any means be approached under the fostering care of a monopoly such as the Corporation are seeking. . . . . If there had been a dearth of electrical contractors in the town, or if contractors had smothered progress by united action in upholding high prices for electrical work, one could understand the Corporation asking for such powers as are embodied in the Bill. But the reverse is the case, as the local electrical contractors have placed more orders than the Corporation electricity works could with any degree of promptitude cope with. If it is reasonable for the Corporation to pose as traders in a new industry (and by their opposition stifle its progress), surely it would be reasonable for them to act in the same capacity in other departments—for instance, the Corporation own the public slaughter-houses; why not buy beasts, cut up, and retail same? Would this be agreeable to certain worthy aldermen and the local butchering trade? The Corporation own certain hotel and public-house property. Why not run a brewery? But this, perhaps, might affect the interests of certain brewery magnates.

For our previous comments on this question we have been ridiculed as believing that it is seriously intended to carry into effect powers such as are being applied for at Halifax. If they are not to be carried into effect, what is the use of applying for them and including the objectionable provisions in a public Bill for traders to take umbrage at? But we are convinced that the clauses are set there for the purpose which we have attributed to them, of entering into actual competition with electrical traders. We read that at Halifax the Mayor is moving in a very spirited way, so as to ensure the ratepayers' endorsement of the measure by an overwhelming majority, and he endeavours to pacify the local electrical engineers by saying that the powers sought by clause 91 are simply "to repair or alter electrical fittings where the Corporation may be requested to do so." We maintain that, in doing even this, the Corporation is entering into competition with some of its own ratepayers. The terms of the clause are for "buying, selling, &c., but not manufacturing." The Halifax electricians, we imagine, will not attach much importance to a statement of intentions which is the direct opposite of what appears in the Bill itself. If the Bill becomes law, what about the "intentions" given by word of

* Since this article was written Mr. Balfour has announced to the House of Commons that he intends putting the Municipal Trading Committee down on the paper without delay.

† Electrical Review, December 29th, 1899, page 1040.

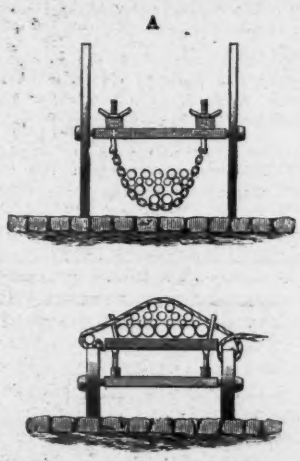
mouth and nothing more? The whole principle of the thing is at fault, and whether the Corporation proposes to go the whole hog, or only part, does not matter. The thin end of the wedge is already in, unfortunately, and the explained intentions are nothing more nor less than an attempt to drive it in a little further. Like all other clauses of the kind, those of the Halifax Corporation should be met with the most strenuous opposition by all interested in maintaining independent enterprise and trade.

THE CONSTRUCTION OF OVERHEAD EQUIPMENTS.

I.

Though it is an importation from America, the methods of overhead construction have not so far been characterised by much in the way of machinery. Probably it has been found that the conditions are so variable that manual labour best adapts itself to them. In this article we propose to give a brief account of the work of construction of an overhead line for tramway work, with a view to pointing out some of the difficulties that have been encountered. These difficulties will be more or less labour difficulties, according to the district in which the work is being done, to some extent, but chiefly depending upon whether the work can be done in a straightforward manner without the delays and demoralising stoppages that prevent the keeping together of a good practised gang of men. After working together for a day or two the members of a gang will be found to work like a machine; each man knows his own particular duty, and the time to do it. But where any of the members of the gang are removed, and their places filled by inexperienced men, the time required to do the work will be doubled or even trebled.

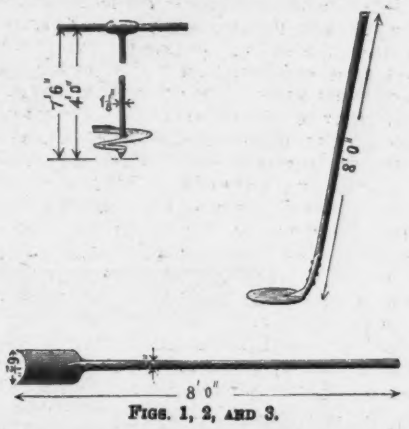
In the overhead system of construction, the standard distance apart at which poles are placed is 40 yards. This distance requires to be shortened considerably in passing round curves, and this is more especially the case when bracketed poles are employed. On the span wire system the trolley wire where passing round curves may easily be pulled



off from the chord position so as to bring the wire at any point within the allowed limits of deviation; on the other hand, with bracket poles the system of pull-offs cannot be applied unless the poles are upon the convex side of the curve, while the same argument applies, of course, to one side of a centre pole line. But the distance apart of the poles exercises no serious influence on the general problem of construction. The work of pole erecting may be divided under three heads, namely: (1) The excavation of the holes; (2) the putting of the pole into the hole prepared for it; (3) the fixing of the pole truly vertical or at the predetermined angle of rake. There is an earlier operation that might almost have been placed under a heading of its own—the placing of the pole in the proper position on the ground ready for erection. This usually includes threading upon the pole the cast-iron ornamental base and tying this to the pole at such a position that its lower end is at least 7 feet above the butt end of the pole itself. This is done to facilitate the subsequent concreting operation. It may happen that the poles have been laid along the route some considerable time in advance of the work. In order that they may not prove a danger to the public they are best laid singly in the gutter close along the kerb. So laid, they are out of the way, and being tubular, do not obstruct the flow of water to the sewers.

The best vehicle to carry poles to the line is one of those large log trucks with wheels of 9 or 10 feet diameter, as used in Liverpool for large timbers. The poles should be slung below the axle by chains and screws (fig. A), and may be unloaded by pulling out the top pole first at the back end, so that one end of the pole can be lowered carefully on the ground. The other end is then to be lowered by taking a hitch of rope round it, and a double turn round the pole of the drag, and lowering the iron pole thereby. Poles must not be dropped any distance, as they are very easily sprung out of straight and rendered useless. Where such a vehicle cannot be had, the next best vehicle is an ordinary timber dray with low wheels that do not stand so high as the dray platform or transoms. Loose stancheons usually hold the timber balks laterally. To lower off a pole, each end of the most convenient pole should be secured by a rope carried to the wheels on the opposite side of the vehicle. By means of bars the pole must then be gently coaxed past the removed stancheons, and the stancheons at once re-inserted to prevent other poles from slipping off. Obviously, both because of foot passengers on the inside, and because the curvature of the roadway causes the vehicle to slope inwards and helps to prevent dangerous slipping of the other poles, it is better to unload poles on the street side of the vehicle, the wheels of the dray standing down or towards the gutter.

The pole is easily lowered quietly to the ground, resting first on the wheel tyres, and then on their projecting hubs in its descent. With ropes of sufficient length, and a vehicle convenient for the purpose, the poles are made simply



Figs. 1, 2, and 3.

to roll in the loop of the rope, one end of which is secured to the vehicle, and the other is given a turn round the near side wheel (fig. B). The unloading of poles is worth careful attention, as it may be the means of saving expense and preventing accident.

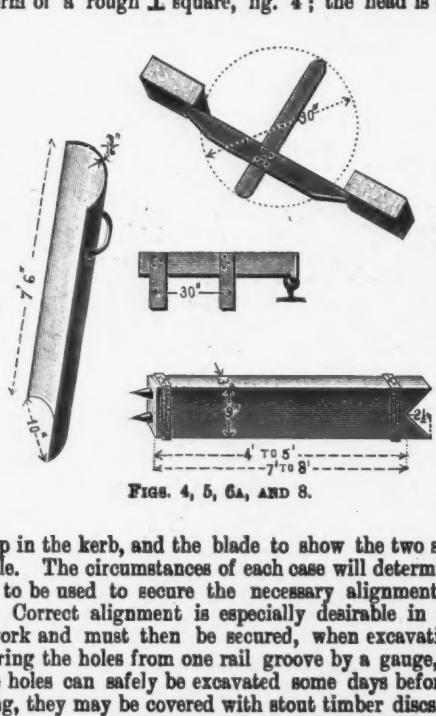
We may assume all poles to have been distributed along the route with their appropriate base castings. The next operation is the making of the holes. Poles are usually buried to about 6 feet from the surface, and holes are dug for the purpose to a clear depth of 6½ feet. The digging of holes is a labour of great uncertainty. The tools employed are the auger, fig. 1, the scoop, fig. 2, and the long cutting spade, fig. 3, and, when the ground is hard, long steel bars are used to break up the rock. These bars are of 1¼-inch octagon steel pointed at the end.

The auger, for use in clay, consists of a miniature screw pile with a short gimlet point and a single flat steel plate helix of short pitch. The diameter is about 12 inches, and progress in wetted clay is fairly rapid. The hole thus made is widened out by the long-handled cutting spades. In

cinders or in rock, progress is more or less delayed. The top diameter of the hole ought to be at least 30 inches to give a proper mass of concrete to distribute the lateral pull of the pole upon an ample area of earth. Below 2 feet the hole may be narrowed in good ground or soft rock to a minimum of 15 inches, which is as small as will conveniently admit the use of the flat spoon scoops used for removing the soil from the hole.

At least a week before the work of pole erecting is to be commenced, there should be prepared a number of slabs of 3-inch flagstone about 15 inches diameter, to line the bottom of each hole. If such slabs are not to be had, their equivalents should be prepared from fine concrete moulded in a rough circular frame of wood or hoop iron. The object of this lining is to afford a hard substance upon which the poles may rest so that they will not sink into the ground further than required. Without such linings, the pole, when it drops heavily into the excavation, sinks into the earth, and cannot afterwards be moved for adjustment. It is a mistake to excavate holes too far in advance of the pole erection, for the sides are apt to fall in; in many soils the holes fill rapidly with water by percolation or become filled by rainfall, and in either case the hole is more or less rotted. It is thus not usually practicable to excavate holes so far ahead of the work as to permit the bottom to be lined with concrete that will have time to harden before the pole is erected. On no account must hard liners be omitted, prepared well beforehand.

A poling gang will consist of 12 to 14 men. With two men to each hole six holes can be excavated at once. Each set of men should have a wooden staff cut to measure the correct position of the hole relative to the line of kerb. For good work, where the kerb is good and straight, a piece of kerb will generally require to be removed in order to allow a hole of proper size to be made. The wooded staff may then take the form of a rough ⊥ square, fig. 4; the head is to span



FIGS. 4, 5, 6A, AND 8.

the gap in the kerb, and the blade to show the two sides of the hole. The circumstances of each case will determine the means to be used to secure the necessary alignment of the poles. Correct alignment is especially desirable in centre-pole work and must then be secured, when excavating, by measuring the holes from one rail groove by a gauge, fig. 5. Where holes can safely be excavated some days before pole erecting, they may be covered with stout timber discs and a layer of earth. In fact, no hole should be left any time without cover, or some wideawake citizen will assuredly find it and fall therein, and if there is water in the hole a child will inevitably fall in head first and become a permanent capital charge on the tramway. Too much caution cannot be exercised in precautionary measures against mishaps. Where the holes made in one day must be filled the same day, the poling gang will usually start excavation in the morning, and the number of holes dug by them should be such as can be finished the same day. Work can be more rapidly advanced when holes can be dug well ahead of the pole gang by a different gang of men, and it is good practice to do this in long lengths of uninterrupted work.

The holes being now ready, the poles are drawn to their respective places, and threaded through their base castings. Four men to each pole will do this rapidly. All is now ready for erection of the prepared poles. A curved $\frac{3}{16}$ steel plate, fig. 6A, is stood nearly vertically, as shown in fig. 6B, in the first hole. This serves as a guide for the butt of the pole as it slides into place.

FIG. 6B.

The other tools for this purpose are a couple of "dead men," being planks about 9 inches × 3 inches of oak or pitch pine, well bound at each end with hoop iron to prevent splitting, cut at the top end to a V very obtusely, and, at the bottom end, spiked to prevent slipping. These are about 5 feet and 8 feet long respectively (fig. 8), and serve to support the pole as it is being raised.

The actual pushing-up poles are eight in number, four being 12 feet in length, and four about 7 feet (fig. 9). The pole is first lifted half up to the position (fig. 7), and the

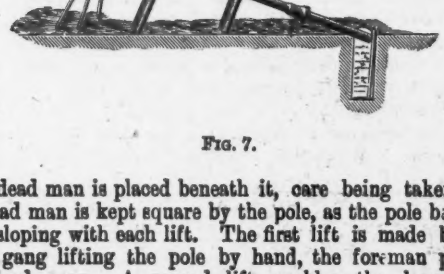


FIG. 7.

short dead man is placed beneath it, care being taken that the dead man is kept square by the pole, as the pole becomes more sloping with each lift. The first lift is made by the whole gang lifting the pole by hand, the foreman placing the dead man. A second lift enables the long dead man to be inserted, as in fig. 7, and the pole is thus pushed up to such an angle, that the four short pushers can be put under the upper end of the pole, as shown, the other men still pushing the pole from below, and

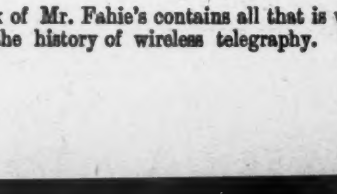


FIG. 9.

the dead man being carefully followed up. A lift in this way enables the long or 12-foot pusher poles to be placed under the pole end, and all eight men lift in unison and the others push or serve the dead men. A little experience renders the work very simple; each man soon finds his place, and the work is eased considerably. As soon as the butt of the pole makes an angle with the back plate of less than 90° on the top side of the pole the safety is increased.

(To be continued.)

REVIEWS.

A History of Wireless Telegraphy. By J. J. FAHIE. William Blackwood & Sons, Edinburgh and London. Price 6s.

This book of Mr. Fahie's contains all that is worth knowing about the history of wireless telegraphy. The author

has spared no pains in collecting the materials for this work, and we should think that very little that is of any importance has been overlooked.

Mr. Fahie traces the beginnings of the idea of wireless telegraphy as far back as the end of the last century, but the real originator of anything in practical form appears to have been Steinheil, who, in 1838, succeeded in telegraphing by means of earth currents to a distance of 50 feet. This idea of utilising the lateral spread of earth currents flowing between the two earth plates of the transmitting apparatus evidently had a great fascination for inventors from the time of Steinheil down to the quite recent advent of Marconi. It is obvious that the system has great advantages, although the wires forming the base lines may be two or three times the length of a wire that would have directly connected the two stations, since it enables communication to be effected where a cable cannot be maintained. Morse, Lindsay, Trowbridge, Preece, and many more or less distinguished men, have tried their hand at this system of wireless telegraphy. The biographical material collected by the author about James Bowman Lindsay, of Dundee, gives an interesting picture of the poor scholar rising superior to his environment, of which Scotland has furnished so many examples. Mr. C. A. Stevenson's system of signalling by means of the electro-magnetic induction between two coils laid flat on the ground at the two stations is fully and clearly described. This system is interesting as being an almost complete anticipation of a system recently proposed by Prof. Lodge, who, at the time he read his paper before the Institution of Electrical Engineers, was unaware of Stevenson's researches. This illustrates the value of such a book as Mr. Fahie's.

The last chapter in Mr. Fahie's book is entitled "G. Marconi's Method." It begins with Newton, and passes through Faraday, Maxwell, and Lodge, to Marconi. Now, though Marconi has been the most successful of all workers at wireless telegraphy, his invention is limited to certain details in working out principles previously known, and it is scarcely fair to classify Lodge's system, for example, as a Marconi method.

What will strike most readers as objectionable about Mr. Fahie's book is the too frequent occurrence of quotation marks. Most of the inventions are described in the *ipsissima verba* of the inventors. Mr. Fahie anticipates this objection in his preface. He says: "I seem to hear the facetious critic exclaim: 'Why this is all scissors and paste.' So it is, good sir, much of it; and so is all true history when you delete the fictions with which many historians embellish their facts." It is said that Froude defined history as an art, not a science. Mr. Fahie evidently does not agree with Froude's definition; but we imagine the most rigidly accurate of historians would trust themselves to give a true account of events without actually quoting the words of the old records. The chapter on the Marconi method is mostly in the language of the author, and is, on that account, much more clear, concise, and pleasant reading.

We cannot endorse Mr. Fahie's theory of the Marconi apparatus. He says: "On depressing the key to make, say, a dash, induced currents are set up in the secondary coil of the Ruhmkorff machine, which pass in sparks across the spark gaps, and out into space at x (the end of the vertical wire). The sparks at x set up electric oscillations in the ether, which are radiated into space in waves. On arriving at the receiving station, some of these waves strike the wire, y (the vertical wire of the receiver), and are carried to the detector, &c." This description is not very clear, but the impression one gets is that sparks discharged from the end of the vertical wire generate electric waves. We doubt if sparks are ever discharged from the end of the wire in the Marconi apparatus. The waves in the wire produce a rapid succession of positive and negative pressures at the end of the wire. The electrostatic lines of force spread from the top of the wire like the ribs of an umbrella to the surface of the earth, and the rapid alternations of this field generate the electro-magnetic waves which transmit the signals.

To show how rapidly the art of wireless telegraphy is advancing, we may compare Mr. Fahie's statement that the greatest range attained with the Marconi apparatus is 35 miles. At the present date it is said to be at least 100 miles.

At the end of the book are various appendices: On the relation between electricity and light; modern views with respect to the nature of electric currents (Rowland); reprint of Marconi's patent specification; researches of Prof. Hughes in electric waves, and their application to wireless telegraphy, &c.

A group of 12 portraits of eminent men who have contributed most to the creation of wireless telegraphy is given as a frontispiece.

Everybody who is interested in the subject of wireless telegraphy should read Mr. Fahie's book. The historical material is all there, though his regrettable views as to the involuntary mendacity of historians has prevented Mr. Fahie from putting it in the most readable form.

The Life Story of the Late Sir Charles Tilston Bright. By E. B. Bright and C. Bright. 2 vols. Westminster: Archibald Constable & Co., 2, Whitehall Gardens.

This biography, written by the brother and son of Sir Charles Bright, is interesting, not only because it is a record of the life of a talented engineer, but also because it gives the story of the Atlantic cable and of the first telegraph to India and the Colonies. The ranks of those who have knowledge of what was done in the early days of telegraphy are becoming rapidly thinned to almost extinction, and were it not for books of the kind under notice, records of what has been done must be practically lost. There is a tendency, we think, for those who write biographies, to imagine that what is of intense interest to themselves must necessarily be of interest to others; whilst, therefore, the records may be useful and of interest to a few, there is always a possibility of a biography, no matter how well written, turning out to some extent a failure.

The biography of Sir Charles Bright is undoubtedly that of a remarkable man. That a youth of 19 should have been entrusted to carry out important telegraph work in Lancashire and Yorkshire, and that at 20 he should have become chief engineer to the Magnetic Telegraph Company, is certainly astonishing, and is an indication of very great ability. Many of the inventions of Sir Charles Bright are, in a modified and improved form, still in use and doing excellent service.

At 26, as the result of his successful completion of the Atlantic cable, Mr. Bright became "Sir Charles," and no honour was more deserved. The account of the voyage of the *Agamemnon*, and the terrific storm encountered in mid-Atlantic, is interesting and exciting reading; indeed, the whole history of the various incidents in the memorable voyages which resulted in the establishment of a working cable reads almost like a romance. In the face of the innumerable difficulties, and the want of knowledge which we now possess, it really is remarkable that the cable was ever got to work at all; 732 messages appear to have been transmitted from first to last. Probably the life of the cable would have been very much longer than it proved to be, had it not been subjected to electrical strains, which, however much they were thought to be necessary, in order to accelerate the speed of transmission, were really disastrous in their effect on the insulation of the cable.

To follow the volumes chapter by chapter is unnecessary, as there is little in them of purely scientific interest. As a faithful and complete record of the family history of Sir Charles Bright, the compilation is entirely satisfactory, and should prove valuable to all who have a liking for biographies of the kind.

THE WIRING OF HOUSES FOR THE ELECTRIC LIGHT.

By ED. C. DE SEGUNDO, A.M.I.C.E.

The change in the voltage at which current is supplied for lighting and other purposes, from 100 to 200 volts, has caused the old question of the proper method of wiring houses for the electric light to come prominently before the technical as well as the lay press, and the result of the present deliberations of the Institution of Electrical Engineers on this subject will be awaited with much interest.

There can be no doubt that the subject is one of great and growing importance, but it is difficult to see how rules

and regulations can effectually protect the public against the consequences of bad wiring any more than Acts of Parliament can make a man honest. There exist at the present time more than one code of wiring rules which, if conscientiously adhered to, would ensure satisfactory wiring, but the crux hitherto has been exactly what it always will be, namely, the introduction of the element of conscientiousness into the work.

A contractor tendering for work knows he is in competition with keen men of business who can calculate as carefully as he does, and who are equally anxious to obtain the contract. If no specification is prepared upon which the contractors have to base their tender, then the amount of conscientiousness imparted into the contractor's tender is that which he considers necessary to ensure his work being passed by the representatives of the supply company and of the insurance company. The inspection by either of these authorities is always made on completion, and provided the installation shows a certain insulation resistance to earth and between poles, and provided there is nothing very glaring in the way of defective design of fitting or apparatus, the wiring is passed, the contractor is paid, and the consumer very naturally feels quite happy about having got his money's worth.

Let us consider what the insulation test as ordinarily applied by the supply company does *not* reveal.

It gives absolutely no indication as to—

1. Quality of insulating material on conductors.
2. System on which wiring is carried out.
3. Capacity of conductors.
4. Whether joints are properly made or not.
5. Whether fuses are inserted where necessary.
6. Whether fuse wire is properly proportioned to current which may safely pass.
7. Whether conductors are bunched or not.
8. Whether conductors are protected in any way from mechanical or other injury.
9. Whether fuses or conductors are accessible in case of injury or breakdown.
10. Whether there is a break in continuity in the conductors.

The supply company's test for insulation resistance is primarily designed for the company's protection, it being of the greatest importance to the supply company to know that a connection with a given installation does not put a bad earth or other fault on their system. Should anything happen to the installation in question in the way of a bad short circuit, for instance, the company's main fuse protects its system of conductors, although the consumer's main fuse does not of necessity protect his system of conductors, but as long as the consumer's meter and the company's main fuse remains intact, it would not matter to the company (academically) how long a short circuit in a consumer's wiring were to continue, because, of course, the company's main fuse recognises no difference between a large number of lamps being on, and a short circuit, or other fault, passing an equivalent current, the meter would register the same in each case, and eventually the consumer would be called upon to pay just the same.

The recent experience of Mr. Crackanthorpe, which has been very freely ventilated in the *Times* and in other journals, has called forth letters of all descriptions from those who know what they are writing about, and also from those who do not. Nearly everyone calls for rules and regulations, for a standard system of wiring, for something cut and dried which shall, after the manner of a fetish, render errors of judgment impossible, ensure perfection in workmanship and relieve everyone of responsibility. It is, of course, impossible to ensure sound wiring by merely compiling rules and *going no farther*. The essential is, that the rules should be enforced at least in principle, and this can only be done by efficient superintendence during the execution of the work. Until this is done, the mere provision that the wiring shall be carried out in accordance with the rules laid down by such and such an authority will involve no guarantee that these provisions will be adhered to. Indeed, no code of rules could be so perfect as to apply unequivocally to each and every case of wiring, and it is certain that the blind use of rules without discrimination may very often lead to confusion.

In the Electrical Review of January 5th, a note of warning is sounded by Mr. V. Zingler in connection with the use of rubber-insulated wire in steel conduits. He points out that in advocating the use of steel conduits one is apt to lose sight of the "now recognised perishableness of vulcanised rubber."

With deference, the fact that rubber perishes has long been known and recognised, but so far no efficient substitute has been found for the insulation of wires, and, therefore, one has to accept the inevitable. Mr. Zingler's point is that while the deterioration of rubber insulation may not become apparent if the wires are run in wood casing and if the latter is kept dry, the drop in insulation resistance would become marked in the case of a similar deterioration of a wire enclosed in a steel conduit. This, however, would appear to be an advantage rather than otherwise, provided the conduit system has been properly designed.

The author was consulted in regard to the electrical equipment of the new buildings of the Institution of Mechanical Engineers, and recognising that wires cannot be expected to last for ever, he adopted a system which seemed likely to prove the most satisfactory, not only in the present, but in the future. The fundamental principles set forth in the specification included a rigid system of sub-division, the main circuit being divided up into as many circuits as there are floors, these circuits being again divided into sub-circuits carrying not more than 2½ amperes each to supply individual lamps. Each circuit starts from a double-pole distributing fuseboard, and separate circuits are taken off for motors, experimental plugs or any special purpose.

Draw boxes are introduced wherever necessary or advisable to facilitate either the drawing in or drawing out of wires.

The conduit is composed of special wrought-iron tube, and great care is exercised in the selection of each length. The conduit is *not* insulated in the interior, and no special precaution is taken to make the system air or water tight, in fact, it is preferable that there should be free access of air to the system of conduits, this tending to keep it dry and sweet, whereas if the system is air tight the condensation due to variations of temperature has no means of escape, and the covering of the wires may suffer in proportion. It is doubtful, however, whether in practice it would always be possible to arrange the wiring on an ideal principle, and of necessity, there must be certain portions of the conduit systems to which very little fresh air obtains access. Should Mr. Zingler's fears be realised, it only emphasises the necessity of care and forethought in the selection of positions for the draw boxes in order that the replacing of wires be rendered as little troublesome as possible.

The question of joints is undoubtedly a most important one, so much so that it is better to avoid it as far as possible by not permitting joints at all in the main and distributing circuits. At the Institution of Mechanical Engineers the main and distributing circuits are continuous and without a joint between fuse terminals. It is, of course, possible to make a joint so well that it is quite equal or even superior in insulation to the rest of the wire, but experience shows that in order to ensure such jointing it would be necessary to employ a craftsman of so high an order as would very greatly add to the expense of wiring.

Joints cannot be wholly avoided except at a cost in labour and material which would be quite prohibitive. At the same time, the objectionable features attendant upon joints in the final distributing circuits may be minimised by collecting all the joints for the points which any circuit has to feed, in one joint box, as far as possible, and by placing this in a readily accessible position. As regards the character of the joint, there should be no trouble with mechanical joints in wires up to, say, 7/22, provided always that they are made by a conscientious and skilful workman. The author has seen mechanical joints, which, after a lapse of many years, were apparently in perfect condition, whereas soldered joints in other parts of old wiring showed signs of deterioration, due, no doubt, to the wires not having been properly cleaned before soldering, or to the fact that some form of "solution" had been used, and a little left behind in the joint.

It is doubtful whether any system of wiring will ever be devised that will be universally applicable. The exigencies of each special case will have to be taken into account in matters of detail, but two fundamental principles may be enunciated which apply whatever be the system employed,

namely, sub-division of circuits properly protected by double-pole fuses placed in easily accessible positions should be carried out as far as possible, and joints in the wires should be avoided wherever possible. A third desideratum may be added, that the method of protecting the wires from mechanical injury should be such as to admit of the wires being drawn in or out with as little trouble as possible.

CORRESPONDENCE.

Our Position as Engineers.

On reading in your issue of February 2nd the inaugural address to the Association of Engineers by Mr. Henry Hodgson, one is struck by the fact that the tone in which the President speaks is purely one of competition. He enumerates many branches of engineering, pointing out the position of each as regards other countries, America and Germany in particular. But does he not leave out a most important point to us Englishmen by not mentioning the engineering branch and its working staff of the ships in our Navy? Can that be compared as favourably with other countries? Considering the stage that science has reached at the present day, one would think that these ships would be complete with all the latest inventions and appliances. Instead of this, when one goes on board a new first-class cruiser, one finds instruments in use which are only fit to be consigned to a museum; the dynamo in charge of one branch of the service, the circuits for lighting and other purposes in charge of another (which branches are, generally speaking, at social loggerheads), and it strikes one that something should be done to bring even these minor details up to date.

Would it not be a good thing for the country, if some eminent engineer, an electrician for preference, were to take up the subject, and go into the reasons why electrical knowledge is so small in our Navy, and electrical appliances are so "crabbed" by the officials under the Admiralty?

An Electrical Engineer.

An Inventor's Grievance.

I noticed in your advertisement columns last week an advertisement of an apparatus invented by me two years ago, and submitted to the firm who advertises, but very slightly different from it.

They told me they did not see their way to manufacture the article, as there was no demand for it.

This is not the first time I have been served like this, and I suppose it is a general thing for so-called reputable firms to crib inventors' ideas and then very slightly alter them for their own use, because they know a poor inventor has not the money to contest the thing in a court of law. Also it has been truly said that it takes a genius to make a good invention, but an angel to make manufacturers believe that it is any good.

Disgusted Inventor.

An Electrolytic Centrifugal Process for the Production of Copper Tubes.

My attention has been drawn to Mr. Henry Wilde's letter appearing in your issue of February 16th.

I quite agree with Mr. Henry Wilde that there is nothing new in revolving a cathode, as this has been practised for a great number of years; Mr. Wilde's letter makes it quite clear that his process has no feature in common with my centrifugal process.

What I claim to have discovered is that if the cathode is revolved at a sufficiently high speed so as to generate an appreciable amount of centrifugal force, remarkably smooth deposits can be obtained at very high current densities, and the voltage is considerably reduced. I have also observed that there is a critical speed at which excellent copper deposits can be obtained, which cannot be obtained at a lower speed.

I am well acquainted with Mr. Henry Wilde's patent in which he claims imparting a rapid whirling, or rotating motion to a depositing solution either by means of paddles or revolving the electrodes. I am not aware that Mr. Henry Wilde had discovered that by rotating the cathode at a certain speed smooth deposits of copper could be obtained at remarkably high current densities, even when a very large percentage of free acid is present in the electrolyte. If Mr. Wilde had appreciated the advantages of centrifugal force, why does he state in his patent that a paddle revolved in the electrolyte is a good substitute for revolving the electrodes? The American patent authorities after carefully studying Mr. Henry Wilde's patent, have decided to grant me a patent for my centrifugal process.

Sherard Cowper Coles.

February 20th, 1900.

Electrical Volunteers' "Send-off" Dinner.

The Dinner Committee have the gratification of announcing that Lord Kelvin has most kindly consented to remain in London a week longer than he had originally intended in order to preside at the "Send-off" Dinner on March 3rd.

In order that the final arrangements for the dinner may be completed without loss of time, the hon. treasurer (Mr. Henry Edmunds, 2, Queen Anne's Gate, London, S.W.) would be glad to receive remittances (£2 each) as soon as possible from those gentlemen who wish to be present (or to act as hosts without attending) but who have not yet communicated with him on the subject.

W. G. McMillan,
Hon. Secretary to the Dinner Committee.

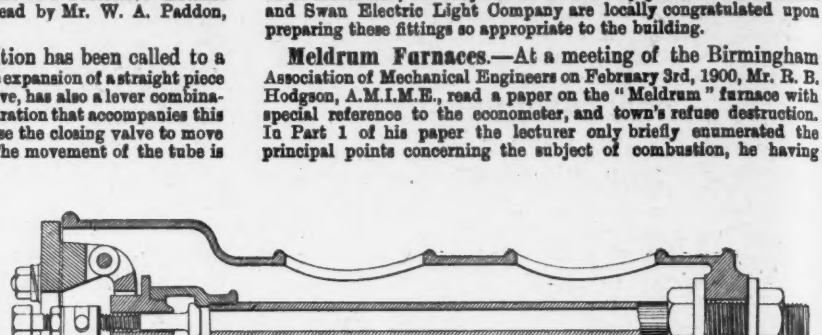
February 20th, 1900.

BUSINESS NOTES.

The Institution of Junior Engineers.—At a meeting of this Institution held at the Westminster Palace Hotel on Friday, February 2nd, the chairman, Mr. Basil H. Joy, presiding, a paper on "Arc Lamps and Arc Lighting" was read by Mr. H. G. Cotsworth, member. After briefly describing the more important phenomena of the electric arc, including the different formations of the carbon points working with direct, alternating, and enclosed arcs, the author reviewed the means available for actuating the "striking" and "feeding" mechanism. It was shown that the thermo-electric method offers decided advantages over electro-magnetic, for instance, with alternating currents an alteration in the periodicity has no effect on the regulation, as would be the case with an electro-magnetic control. The thermo-electric system would, in fact, work equally well with alternating or continuous currents; it had, however, not come into practical use to any extent. The majority of lamps have their mechanism controlled by both a series and shunt solenoid; but lamps in which the series coil is replaced by a spring or counter-weight, are equally successful, and the current through a "shunt" lamp may be varied over a very wide range without affecting the feed; they are also simpler in construction, and therefore cheaper in first cost. Lamps of American origin are nearly all controlled by a clutch, acting direct on the upper carbon guide rod, and are liable to give a spasmodic feed, owing to the wear of the clutch on the rod; but on the Continent a mechanism having a clockwork escapement finds most favour. In England the prevailing type has a wheel controlled by a brake, resulting in a very sensitive and accurate feed being obtained. In referring to the working of the lamps, the author remarked that arcs when run in series must be provided with an automatic cut-out, so that in the event of the lamp failing, the circuit would not be broken. For street lighting the cut-out is best placed in the plinth of the lamp-post; on a short series, however, the cut-out may be dispensed with, but means must be provided for breaking the circuit of the shunt coil, otherwise on the failure of a lamp this coil would be burnt out. Alternating arcs may be run in series across the primary mains, and if provided with a small choking coil across their terminals the extinction of one lamp does not affect the others. Another ingenious method provides a means of running alternating arcs in series with a constant current off constant potential mains. This is accomplished by having a transformer so arranged that when the current in the secondary increases, due to the cutting out of lamps, it reacts on the iron core of the transformer causing more or less magnetic leakage across a short air gap between the coils of the primary and secondary. Alternating arcs do not give the same efficiency as direct, and attempts have therefore been made to rectify alternating currents into direct, resulting in an increased efficiency of the lamps, but introducing rather complicated apparatus at the station. The author, in dealing with enclosed arcs, mentioned that although the actual efficiency was increased by their use, the necessity of having two dense opaloid globes more than counteracted any gain; and he described a lamp which to some extent has the advantages of the enclosed lamp without its corresponding disadvantages; it has but one globe, works at about 80 volts across the arc, and burns for 70 hours with one trimming. Recently an enclosed lamp working

at 160 volts across the arc has been placed on the market, which is intended for running singly in parallel on 200-volt mains. In the discussion which ensued, Messrs. A. S. Arundel, E. C. Roche, F. Arundel, A. F. Gatrill, A. W. Marshall and others took part; and a vote of thanks having been accorded the author, the proceedings terminated with the announcement of the ensuing meeting on March 2nd, when a paper on "Electrolytic Zinc as a Protective Metallic Coating for Iron and Steel," would be read by Mr. W. A. Paddon, member, of Wrexham.

A New Steam Trap.—Our attention has been called to a new steam trap, which, while acting by the expansion of a straight piece of tube against the face of the escape valve, has also a lever combination, very imperfectly shown in the illustration that accompanies this description, the object of which is to cause the closing valve to move forward to meet the expanding tube. The movement of the tube is multiplied several times, so that the usual difficulty experienced with these expansion pipe traps has been grappled with, and, it is claimed, has really been overcome. Without such multiplying movement the expansion due to the difference of temperature of the steam and of the water collected in the pipe is too small to allow satisfactory working; the trap becomes too delicate, and is apt either to leak continually or to refuse to act. The object of the lever movement is good, and though it is risky to prophesy upon the action of a steam trap, we can at least say that if we apprehend the mechanism aright it appears likely to succeed. The expansion of a short straight length of brass tube between the limits of the temperature of the steam and the water to be discharged is very small and could not be practically utilised in a direct line, for it would effect far too small a valve movement to be of use. Hence the application of some simple multiplying levers as in this trap to secure under valve opening. To remove the levers and adjusting screw and expose the valve, the removal of the four nuts is sufficient, when the front cover can be brought away at once. This trap seems simple, and the action is, we are told, very direct upon the tube though, as stated above, the illustration does not show how the pressure is communicated between the tube header and the levers. All inquiries respecting the "O.S." trap should be sent to Mr. J. C. R. Okes, of 63, Queen Victoria Street, E.C.



The Westinghouse Gas Engine.—We have received a pamphlet illustrative of the Westinghouse gas engine that is later on to be put on the market from the new works of the company at Manchester. The engines are to be built in two and three-cylinder variety and of large size. We are glad to welcome another serious effort to produce large gas engines, and can see no reason why such engines should not be as workable as small ones. There is so huge a field for gas engines and so great a volume of waste gas only waiting to be used by them, that it is simply a marvel to us that more is not done to use so cheap a means of energy in power distribution. The pamphlet is quite a work of art and finely illustrated. We have already stated that the governing of the Westinghouse gas engine is effected, not by cutting out explosions, but by modulated charges, a system that while less economical, enables the maximum possible number of explosive strokes to be made. This system is of course open to any gas engine maker to employ; there is not, nor so far as we know ever has been, any patent in it, and, as all gas engines will work with cheap producer gas, or the gas from blast furnaces, and not with costly illuminating gas, the question of steady turning is quite as important as any economy of a cheap gas. The use of the cheaper gases has, in fact, quite altered the position of gas engine economy, and it is worth while again emphasising this point, because there still remains an unnecessary hesitation in the minds of power users against the large gas engine, a prejudice which took its rise at the time of the original Otto and Langen, jun., engine, and has, not without some reason, continued to the present day, chiefly because a means of working, rendered necessary by the cost of gas, has been continued after the main factor has ceased to be. Among other large gas engines, one of 600 H.P. was recently started in Belgium, driving a blowing cylinder direct; and Germans at Dortmund are using gas engines to produce calcium carbide, using blast furnace gas in the engines.

Chatham Town Hall Electric Fittings.—With further reference to the electric lighting of the Chatham New Town Hall, mentioned a few weeks ago, we understand that the handsome electric light fittings, specially designed to harmonise with the building, were worked out and made at the Edison & Swan Company's Ponder's End factory. They are all finished in polished brass. In the main entrance to the Town Hall building are three 5-light fittings; a feature of these being that the town arms with shield is worked into the design. The staircase hall is lit by three 5-light electroliers, and fitted on the Newel post is a massive standard. In the committee room and the offices of the borough officials are fixed 3-light pendants, somewhat plain in design, but in keeping with the general character of the place. On the hall landing of the staircase another Newel standard is placed as at the foot of the stairs. The first floor staircase hall has two 10-light electroliers to light it. In these fittings the lamps are arranged in two tiers for the purposes of economy and effect. The Council chamber, Mayor's parlour, &c., which are fitted, the former with two 10-light electroliers with "shaped" and scroll bands, and the latter with two 5-lights of similar style. The Town Hall proper contains the largest electroliers in the building. The grand 30-lights in the centre have a corresponding (in design) 20-light on either side. Special attention was given to the designs of these electroliers, the ornamentation being so arranged on the "angle-bands" that from any point of view nothing is lost to the eye. There are other fittings in rooms and offices, in addition to those mentioned, but they are of an ordinary pattern. The Edison and Swan Electric Light Company are locally congratulated upon preparing these fittings so appropriate to the building.

Meldrum Furnaces.—At a meeting of the Birmingham Association of Mechanical Engineers on February 3rd, 1900, Mr. R. B. Hodgson, A.M.I.M.E., read a paper on the "Meldrum" furnace with special reference to the econometer, and town's refuse destruction. In Part 1 of his paper the lecturer only briefly enumerated the principal points concerning the subject of combustion, he having dealt fully with that subject in a previous paper read before the Association, passing on to the question of the steam jet blower. He pointed out that although all mechanical stokers with moving grates used the steam jet to keep certain parts of the machine cool, yet most makers suppressed any mention of that fact on account of having to meet with so much prejudice from steam users, by reason of their not having a full knowledge of the office of forced draught. A good selection of results of tests were given to support the lecturer's remarks; some of these showing an increased evaporation of 50 per cent. without loss of fuel efficiency, whilst in some cases a 50 per cent. saving was shown. In Part 2, the construction and working of the Meldrum furnace was fully described by means of numerous lantern slides. Part 3 consisted of a description and explanation of the working of the econometer, or gas weighing apparatus, showing the usefulness of the econometer as a check on careless stokers, and also as a regulator of the air supply to boiler and other furnaces. In Part 4 the lecturer dealt with the much discussed subject of the destruction of town's refuse, showing what form a modern destructor should take. Some tests of the Hereford and Rochdale destructor were given, and after describing the system of heat storage, obtained by means of high pressure boilers, the Darwen electricity works and refuse destructor were described, calling attention to the fact that this plant was being run entirely by refuse burned without the assistance of any other fuel, 1½ lbs. of water being evaporated per pound of refuse. A steam pressure curve for a 24-hour run was shown, and this curve did not fall much below 200 lbs. per square inch, that being the pressure the boilers were arranged to carry. The lecturer said that the Darwen combined plant was one of the finest and most efficient in the kingdom, and the all-round result from refuse burning was the best that had yet been obtained. A discussion followed.

Steel Conduit Wiring.—Messrs. Beecroft & Wightman, Limited, of Bradford, are introducing Hudson's patent wood-lined steel conduit. They claim for it perfect insulation, the absence of junction boxes, that the wires are instantly accessible at any point, and that the conduits are easily fixed, at the same time effecting a saving in cost.

Arc Lamps.—The British Blahnik Arc Light Company, Limited, send us particulars of their new 1899 arc lamp, designed especially for street lighting, docks, railways, and similar situations where severe treatment is likely to be experienced. The lamp is open type and has a metal brake, which is claimed to be extremely sensitive and very powerful, and, being metal playing upon a metal surface, will not wear out nor lose adjustment. The metal in each case is gun-metal, and is not subject to corrosion nor surface deposit, and will resist the action of a sea-water atmosphere. The makers claim that the perfect control, high sensitiveness, and gripping power of this metal brake are such that the feeding together of the carbons is very steady and gradual, and the light, therefore, emitted from the arc is constant. We understand that the mechanism is enclosed in such a manner that no dust can get in; the globe gear and carbon guide rods are so arranged that they do not cast any shadow on the globe; the globe lowering gear is quite rigid. We are informed that a large number of these lamps are at present working on different installations, and the makers' name has been placed upon Admiralty and War Office lists.

Willing's Press Guide.—The 1900 issue of this press guide maintains the reputation of the publication for accuracy, completeness, and excellence of arrangement. It will be found of use as a guide to the press of the United Kingdom, including newspapers, magazines, directories, &c. It is published at 125, Strand, W. (27th annual issue.)

Auction Notice.—Tenders are being invited for the purchase of the Madelvic Motor Carriage Company, Limited (in liquidation), of Granton, Edinburgh, as a going concern. See further particulars among our auction advertisements this week.

Bankruptcy Proceedings.—A receiving order has been made against Benjamin Symmons (B. Symmons & Co.), electrical engineer, North Street, Brighton, on debtor's own petition. The first meeting of creditors and public examination are to be held on February 28th, and March 1st respectively, the former at 24, Railway Approach, S.E., and the latter at Brighton.

A receiving order has been made against A. R. Earle, electrical engineer, Theatre Street and Dial Yard, Norwich.

At the Bath Bankruptcy Court last week, Alex. MacTavish, electrical engineer, appeared for his examination. Answering the Official Receiver, debtor said he started with £100, given to him by his sister who had also lent him money. The examination was concluded.

Books Received.—"Standard Polyphase Apparatus and Systems," by M. A. Oudin. London: Sampson, Low, Marston & Co.

"Polyphase Electric Currents and Alternate Current Motors," by S. P. Thompson. London: E. & F. N. Spon, Limited. 21s.

Catalogues, &c.—The Westinghouse Companies' Publishing Department send us a copy of their fully illustrated circular, No. 1,015, entitled "Transformer Fuse Blocks, 1,000—3,000 volts," which has just been published.

The Spiral Globe, Limited, of Bush Lane, E.C., sends us an illustrated priced catalogue in which the spiral globe is described with a number of diagrams showing its application to electric lighting purposes, and the economy which follows.

Messrs. R. E. Hattersley & Co., of Halifax and Bradford, have issued a pamphlet describing their milling cutters, adjustable blade reamers, and gear cutting. The list is illustrated and priced.

Messrs. Connolly Bros., Limited, of Manchester, have issued a supplementary price list (February, 1900) of insulated wires and cables. This list has been rendered necessary by the continued high rates ruling for many months past in the prices of materials. Since the issue of their last catalogue the firm have added still further to their means of output.

From the Hart Accumulator Company, Limited, there comes to hand a catalogue well arranged, illustrated and printed, giving particulars of their accumulators for the lighting, traction, central and S types. The details of capacity, dimensions, weight, price, &c., are given in tabulated form, and in addition we notice a new feature which it is thought will be of considerable assistance to contractors, viz., the cost of erecting batteries. A special list is made of complete batteries capable of maintaining a small number of lamps for different periods of time.

Messrs. Read, Holliday & Sons, of Huddersfield, send us a number of circulars relating to their incandescent lamps, cables and wires, dynamos and motors.

A set of illustrated lists to hand from Messrs. E. F. Moy, Limited, deal with porcelain bridge fuseboards, fuses, cut-outs, also Acme two-way shunt regulating, automatic, and other switches.

Messrs. Michaelsen & Heine, of Gracechurch Street, E.C., send us particulars of their Diener's metal cement, with results of tests made at the Royal Technical University, Berlin-Charlottenburg. Among numerous other uses for which it is said to be suitable is the fixing of insulators in electrical and telegraph work.

No. 53 of the B.T.H. series of pamphlets is devoted to the carbon feed alternating enclosed arc lamps.

Particulars of Wilson's motor starting switches are given in a small pamphlet issued by Messrs. W. McGeoch & Co., of Birmingham. Messrs. McGeoch say that their starting switch has been made specially to meet a want which has been experienced by electrical engineers, both consulting and practical, for a satisfactory motor switch to answer the requirements that this article has been manufactured to meet. For the convenience, particularly of London friends and consulting engineers in the City, samples of the switch have been placed on view at their London showroom, 11, Charing Cross Road, W.C.

Messrs. Hathorn, Davey & Co., of Leeds, have brought out a new catalogue of pumping machinery for mines. The information set forth here is divided into three sections: (1) pumping machinery driven by steam power; (2) driven by hydraulic power; (3) by belting, ropes or electric motors. The catalogue is well got up and contains many illustrations.

Concerts, &c.—The Cricket Club of the Chelsea Electricity Supply Company, Limited, held their third annual smoking concert at the Pier Hotel on Friday week. The chair was taken by Mr. Percy Still, A.M.I.C.E.

On Thursday last week the staff of the Aberdeen Corporation Electric Lighting Department, and representatives from the Gas Department, met in the Bon-Accord Hotel, to do honour to Mr. George C. Law, the assistant mains superintendent, on the occasion of his leaving Aberdeen to fill a similar position on the staff of the electric light department, Poplar Board of Works, London. Mr. Henderson, mains superintendent, occupied the chair. A presentation of electrical books was made to Mr. Law.

At the Grosvenor Hotel, Broughton, last Friday evening, the warehouse and office staffs of the Greengate Rubber Works and the Irwell Rubber Company were entertained to their annual dinner by the proprietor, Councillor Isidor Frankenburg. Mr. Frankenburg, in responding to the toast of his health, remarked that he intended forming his business into a limited liability company.

The Copper Market.—Messrs. H. R. Merton & Co.'s mid-monthly circular on "Copper" is less reassuring to consumers than any recent issue, for in spite of increasing supplies the price of G.M.B.'s has steadily mounted upwards, and on the 15th of the month stood at £74 17s. 6d. When one recalls the fact that in December, copper was being sold for future delivery at prices under £70, this rebound is disappointing. According to Messrs. Merton's circular, the supplies of copper during the first half of the present month have amounted to 12,477 tons, being considerably above the average as regards shipments from Chili and from Spain and Portugal. The deliveries during the same period have totalled 10,814 tons, and, in addition, 250 tons has been shipped to America from Liverpool and Swansea. The excess of supplies over deliveries is therefore 1,313 tons, and stocks have increased in the 15 days from 21,327 tons to 22,740 tons.

Liquidations, &c.—The Electro-chemical Company, Limited, is winding up voluntarily for the purposes of reconstruction. The liquidator, Mr. Robert Shaw, of St. Helens, Lancs., has power to register a new company with the same name to carry out certain agreements, &c.

The Continental Water and Electrical Power Syndicate, Limited, is winding up voluntarily. Mr. Harry Meredith, of 95, Finsbury Pavement, E.C., is the liquidator.

London County Council.—The Council at the meeting on Tuesday, last week, resolved to lend £44,100 to the Hammersmith Vestry for electric lighting purposes, of which £27,440 was for extension of machinery and mains, and £17,830 to the Whitechapel District Board for the erection of a refuse destructor and electric lighting purposes.

Tramway Conversion.—The Finance Committee reminded the Council that when reporting last August on an estimate of £10,000 for preliminary expenses in connection with the reconstruction for electric traction of the tramways between Westminster Bridge and Tooting, they mentioned having under consideration the period over which the repayment of money expended on reconstruction works should be spread. After conference with the Highways Committee, the Committee had come to the conclusion that the repayment of expenditure on the conversion and equipment of the Council's tramways from horse to electric traction should be distributed over 25 years. It had been necessary to obtain the sanction of the Treasury to the adoption of that course, and the Committee stated that permission had now been given on condition that renewals of appliances and equipment were charged to revenue account during the period allowed for the repayment of the primary outlay thereon. On the recommendation of the Committee, the Council resolved to approve the period of 25 years for the repayment of the £10,000 in question.

Opposition to Electrical Bills.—A report was presented by the Parliamentary Committee in reference to the various private Bills of the present session. The Committee stated that in some cases it might be necessary for the Council to oppose Bills on principle, but in several instances the opposition would only be carried on with a view to the insertion of clauses. It was also probable that the requirements of the Council might be met by amendments being made by arrangement in some of the Bills, so that it would be unnecessary to proceed on petitions in those cases. In addition to the Bills which the Committee suggested should be opposed, they stated that their attention had been directed to other Bills, in the case of some of which it was intended to communicate with the promoters with a view to obtaining the insertion of clauses. Those Bills included the City and South London Railway Bill, the Latimer Road and Acton Railway Bill, the London United Tramways (Extensions) Bill, and the North Metropolitan Electric Power Supply Bill. It was decided on the recommendation of the Committee to seal petitions for presentation, if necessary, against the following Bills:—The Baker Street and Waterloo Railway, the Brompton and Piccadilly Circus Railway, the Charing Cross, Euston and Hampstead Railway, the London, Walthamstow and Epping Forest Railway, and the Whitechapel and Bow Railway, the Charing Cross and Strand Company, the City of London Company, and the County of London and Brush Provincial Electric Lighting Company.

The Battersea Order.—The Council decided with reference to the application for an order by the County of London and Brush Company not to offer any observations with regard to the order beyond suggesting that, if granted, it should be made to conform with other orders already granted to companies for areas within the County of London.

The Highways Committee last week reported that a notice had been given by the Charing Cross and Strand Electricity Supply Corporation, under the City of London Electric Lighting Order, 1899, of their intention to lay mains along Carmelite Street, and in the Victoria Embankment subway as far as the western boundary of the City. They thought that the proposed works might be approved, subject to the usual conditions relative to the works affecting the subway; and recommended accordingly. This was approved.

Sentence.—At the London County Sessions last week, before Mr. McConnell, Q.C., sitting at Newington, Edward Capel, 19, an electrician, pleaded guilty to three charges of larceny. It was stated that the prisoner had been in the habit of going to the houses of customers (at Brockley) of his former employers, a Greenwich electrical firm, gaining entrance on the pretence of having come to examine the electric wires, and stealing whatever he could lay his hands on. He was sentenced to 15 months' hard labour.

20s. in the £.—Notice of a dividend of 20s. in the £ in *re* the London Provincial Electrical Company, Limited, of 110, Cannon Street, E.C., is registered in the *London Gazette*. It is payable at the Official Receiver's offices, 33, Carey Street, W.C.

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Trade Announcements.—The British Electric Company, Limited, report very good business. They have received some important Government contracts, and in consequence the electrical side of their business is now running night and day, and will continue to do so for at least six months. The British Electric Company, Limited, are producers of the Stellite fittings recently described in these columns.

Wire Tables.—Messrs. W. T. Glover & Co., Limited, are issuing to the trade two tables showing the relative dimensions, weights, lengths, and resistances of pure copper cables, wires, and town lighting cables. The tables have been calculated from the formulæ adopted by the Committee on Copper Conductors in May, 1899, and recently published in the ELECTRICAL REVIEW. It will be remembered that the Committee consisted of representatives from the General Post Office, the Institution of Electrical Engineers, and eight principal manufacturers of rubber insulated cables in the United Kingdom. The figures calculated out on the basis of the universally adopted formulæ should therefore be of considerable service to the trade.

ELECTRIC LIGHT AND POWER NOTES.

Bala.—The District Council is going to summon a public meeting of the ratepayers to consider the question of electric lighting.

Barnsley.—The Corporation electricity works commenced operations successfully on Saturday last, with about 70 consumers. The station is equipped with three generating sets, consisting of Johnson & Phillips dynamos coupled to Willans engines, and each capable of supplying 2,500 8-C.P. lamps, at a pressure of 230 volts, while a 5,000 lamp set is on order. A battery of accumulators is installed. The boilers, three in number, were made by Messrs. Arnold & Co., of Barnsley. The prospects of the undertaking are said to be very favourable.

Bath.—The deficit in the electric lighting accounts amounts to £1,967, which will be provided out of the rates. The charge for supply is to be reduced to 4½d. per unit from June 30th next, with a discount to large consumers.

Bedford.—The accounts of the Bedford electric light undertaking show a total revenue of £8,798 for the past year, and net revenue £3,917. After paying interest and sinking fund, there is a net loss of £288 on the year's working.

Beverley.—The Town Council has decided to engage Mr. A. H. Gibbings, consulting engineer, to report on the expediency of introducing the electric light into the borough.

Birkenhead.—The Corporation has given out a contract for the new buildings for electric tramway power station to Mr. W. H. Forde at £10,426.

Bootle.—The Town Council has passed a resolution "That the electrical engineer should prepare a detailed report up to March 31st upon the electric traction, electric lighting, and the cost." Councillor Bell said that no encouragement was given to ratepayers to use the illuminant supplied by the Corporation, and that a great number of people who had entered into arrangements to be supplied with electric light on their premises were very much disgusted at the attention which had been paid to them by the officials of the Corporation. He was of opinion that the Corporation could make a good commercial transaction out of the electric lighting. Aldermen M'Murray, referring to the electric trams, remarked that certain terms had been made with the Corporation of Liverpool with reference to the matter. The tramway track had been passed, and the electric power plant had been approved by the Board of Trade. With regard to the question as to when the electric trams would be running through the borough, he said that the matter rested with the Corporations of Liverpool and Bootle. If Liverpool accepted the terms offered by Bootle, the trams would be set in motion at once.

Brighton.—The Town Council has resolved to assist the Lancashire Corporations in their opposition to the Lancashire Electrical Power Bill. As the Brighton Corporation is endeavouring to obtain powers precisely similar to those sought by the company, viz., to supply electricity in districts controlled by other councils, it is difficult to see on what logical basis the Council can justify its interference.

Chester.—The Lighting Committee of the Chester Town Council is recommending the Council to extend the electric light works, and to obtain authority to borrow £30,000 for additional mains, services, lamps, &c.

Chesterfield.—The Electrical Energy Committee of the Town Council last week recommended that application be made to the Local Government Board for sanction to borrow £25,000 for the purpose of carrying out a scheme of electricity supply prepared by the Westinghouse Company. The report was adopted by the Council.

Dublin.—A gas explosion occurred in a manhole of the electric lighting system last week, breaking the cover, but otherwise no serious damage was done.

Edinburgh.—The Town Council has accepted the tender of Mr. G. Sinclair, Leith, for four boilers for the sum of £4,800; and that of Messrs. Mather & Platt, Salford, for two steam dynamos of 1,200 H.P. for the sum of £12,319. At a recent meeting Bailie Mackenzie stated that the capital expenditure up to May last amounted to £395,356, with a lamp connection equivalent to 226,740 8-C.P. lamps, giving a capital outlay of £1 15s. per lamp. Glasgow had spent £339,782, with 139,772 lamps, or £2 8s. per lamp; Dundee, £1 13s. per lamp; Aberdeen, £1 14s. 6d.; Manchester, £2; Liverpool, £3 4s.; Leeds, £2 18s.; Birmingham, £2 10s.; Sheffield, £3; Dublin, £2 14s.; Belfast, £2 8s; Brighton, £2 4s. Of the London companies the City Company has a capital of £3 18s. per lamp; the Metropolitan, £2 12s.; the Westminster, £2 6s. The new plant is to be at work in September this year.

Gas explosions took place in two of the manholes of the electricity mains last week. The covers were smashed, but no one was injured.

Glasgow.—In order to meet the requirements for electric current at Kelvinside next winter it is proposed to extend the works taken over from the Kelvinside Electricity Company, by laying down a water-tube boiler costing £1,362, three engines with dynamos costing £7,656, and accessories estimated to cost £3,000.

Grimsby.—A Local Government Board inquiry was held at Grimsby on Monday last, with respect to the application of the Town Council for sanction to borrow £11,500 for purposes connected with the supply of electric power in the borough. The deputy town clerk stated the original amount authorised to be borrowed was £43,500, and the total now required would be £55,000. There was no opposition.

The Town Council on Tuesday decided to apply to the Local Government Board for leave to issue Corporation 3 per cent. stock, some £60,000 being required for electric lighting and other public works.

Guildford.—The Town Council has resolved to enter into negotiations with the Guildford Electricity Supply Company, Limited, with a view to the purchase of the company's undertaking.

Hanley.—The Town Council has resolved to apply to the Local Government Board for sanction to borrow £4,000 for extension of the electricity works.

Hastings.—The Town Council has accepted the tender of the Electric Construction Company, Limited, for transformers, as and when required, during the current year; of Messrs. Cowans, Limited, Salford, for switch gear for eight sub-stations, at a cost of £1,548 16s., and according to schedule; of Messrs. Higginbottom and Mannock, West Gorton, for an overhead crane, for the sum of £313; and of the Edison & Swan Company, Limited, for 5,000 200-volt lamps at schedule prices.

Hoylake and West Kirkby.—The District Council has resolved to invite tenders for the erection in Hoylake of a generating station for electric lighting.

Hungary.—The Buda-Pesth branch of Messrs. Schuckert and Co., of Nuremberg, has just been formed into a separate company, with a capital of 800,000 kr.

Ilford.—The electric lighting scheme, which is estimated to cost £60,000, has been approved by the Local Government Board.

Italy.—A company has just been formed in Milan, to be known as La Impresa Laurensana di Applicazioni Elettrichi. The object of the company is to put down plant to utilise a waterfall in Isola del Liri, and to establish large electro-chemical works.

Leicester.—A Local Government Board inquiry was held on the 14th inst., at Leicester, into the application of the Corporation for sanction to borrow £100,000 for electric lighting purposes. The inspector stated that in 1897 a Local Government inquiry was held in Leicester, whereat sanction to borrow the sum of £33,719 for electric lighting was asked for. This sum was divided into two items. The first item, £3,526, was to cover an excess of a loan previously sanctioned, and the second item, amounting to £30,193, represented capital expenditure proposed to be incurred. The inspector detailed the work thus proposed to be done in connection with the second item, and said that to-day it was stated it had been carried out accordingly; not only so, but there had been an excess expenditure of £13,732. He therefore asked for the causes of this excess.

The engineer, Mr. Colson, in reply to the inspector, explained that the works, &c., amounting to £30,193, had all been duly carried out, and the excess expenditure was rendered necessary by the extremely rapid growth of the demand, which had more than doubled since the last inquiry in 1897; the output for the half-year ended December 31st last was 437,943 Board of Trade units, an increase of 45 per cent. on the previous year's record. From June 30th last, the charge has been reduced from 5d. to 4d. per unit for lighting, and 2d. per unit for power, with the result that 31 motors have already been fixed. The capacity of the present central station is equal to 1,400 KW., or, allowing for a spare machine, say, 1,050 KW., with a total boiler capacity somewhat short of this. The maximum demand for electricity this winter has reached 880 KW., leaving a margin of 170 KW. only. In view of the increasing number of lamps installed, together with the strong feeling in favour of the electric light throughout the town, it is clear that a substantial increase of plant and cables must be provided before next winter. This being so, Mr. Colson has recommended a considerable extension of the central station, which, when completed, will contain four additional alternators of 1,000 KW. each; to meet the immediate probable requirements, he has advised the erection of two of these machines, and five boilers, together with the necessary auxiliary apparatus. This would bring the capacity of the station up to 3,400 KW., with an equivalent amount of boiler power.

The engineer has also advised an extension of both high and low tension mains, together with the necessary sub-stations, transformers, &c. The following is the engineer's estimate of the cost of the work referred to:—

Engine and dynamo room—superstructure	£6,461	
Boiler house—superstructure	2,822	
Foundations for building and machinery	8,430	
Chimney stack and flue	770	
		£17,983
Engines and alternators (two sets)	20,429	
Exciters (two sets)	1,200	
Boilers (five), steam pipes, &c.	4,500	
Pumps	421	
Economisers	2,280	
Steam, exhaust, and water pipes	1,577	
Travelling crane	950	
Switch gear	2,500	
		33,857
High tension mains into town	4,200	
High and low tension distributing cables	10,200	
Pipes and trenching	4,764	
Services	2,500	
Joint and fuse boxes	1,900	
Meters	2,625	
Sub-stations and transformers	7,190	
Switch gear for chambers	1,049	
		34,428
		£86,268

The total cost of the extensions thus amounts to £86,268, which, together with the sum of £13,732 already overspent on capital account, amounts to £100,000, the sum the Corporation is applying for. The following table sets forth the financial result of the working of the department from the commencement:—

	Received. Total.	Expended. Interest.	Sinking fund.	Loss.	Profit.
	£	£	£	£	£
Year ending December 31st, 1894	382	508	130	190	—
Half-year ending June 30th, 1895	968	622	588	952	—
" " December 31st, 1895	1,573	630	590	195	—
" " June 30th, 1896	1,670	630	594	723	—
" " December 31st, 1896	3,068	630	590	—	457
" " June 30th, 1897	2,402	629	592	216	—
" " December 31st, 1897	3,654	726	582	—	449
" " June 30th, 1898	3,559	1,137	582	—	46
" " December 31st, 1898	5,331	1,048	1,554	—	645
" " June 30th, 1899	5,040	1,311	1,008	—	837
	£27,642	£4,736	£6,890	£2,276	£1,934

Total net loss at the end of June, 1899, £342, but the profit for the half-year ending December 31st last more than equals this amount.

At a later stage Mr. Colson stated that on the past half-year there was a profit of £1,089, and, after paying off the total net loss at the end of June, 1899, namely, £342, there was a net gain of £747. Those figures had not yet been audited, but he did not doubt their accuracy. He knew of no undertaking occupying so enviable a position as regards capital outlay as their Leicester works, or which got such eminently satisfactory results as regarded expenditure; indeed, experts said the Leicester Corporation undertaking was the most up to date and scientific of any in the country. He knew of none to surpass it, and very few to equal it. The capital outlay worked out at only £65 per KW. capacity, and there was not another electricity-works undertaking in the country that showed anything like so favourable a figure for capital expenditure, while the new station would work out at a still less cost per kilowatt. At the present rate, he did not think it would be many years before they would be applying for another loan—he did not think more than three or four years.

Alderman Lennard added that it would depend partly on how soon they reduced the price again.

The inquiry was then closed, there being no opposition.

It is interesting to note that during the last half-year the output of the gasworks, which is also under the management of Mr. Colson, has increased by over 12 per cent., in spite of the competition of the electricity supply.

Limerick.—At a meeting of the Limerick Corporation last week Mr. Fraser entered into details of the Shannon Water and Electric Power Scheme. It is proposed to construct a canal from the World's End, at the junction of the Grand Canal with the Shannon, above Castleconnell, to Clonlara, two miles away, where the electric works will be situated for the generation of electric power for distribution in Limerick and elsewhere. Another canal, or tailrace, will convey the water back to the Shannon. The cost of these will be about £200,000, and another £100,000 will be spent on turbines and plant. The fall secured at Clonlara is about 40 feet. Sir Robert Kane in his "Industrial Resources of Ireland" pointed out in 1840 that there was a fall of 97 feet in the Shannon between Killaloe and Limerick, and that would produce 33,000 H.P. Mr. Fraser went on to say that the expert evidence to be given in the House of Commons will show that instead of being an injury to the fishing, the washing away of the spawning beds will be prevented by checking the heavy flooding of the river. Safeguards will be introduced in the interests of the Limerick Waterworks. The scheme was referred to a committee, Mr. Fraser undertaking on behalf of the promoters to pay 100 guineas to an expert appointed by the Corporation for the purpose of reporting on the scheme.

The Nenagh District Council has unanimously resolved to support the scheme, while the Scariff Council has taken the contrary view.

Liverpool.—The Local Government Board has given its sanction to the borrowing by the City Council of the sum of £300,000 for purposes connected with the supply of electrical energy.

London.—ST. GEORGE'S, S.E.—The Vestry has resolved to petition against the County of London and Brush Provincial Electric Lighting Company's Bill.

ISLINGTON.—The Vestry has accepted the report of the Electric Lighting Committee recommending the addition of water storage tanks of 60,000 gallons capacity, and various improvements in the electricity supply station buildings, at a cost of £7,500. Acting on the assumption that the delay of the London County Council in granting the electric lighting loans is due to a misconception on the part of the Council of its duty as a sanctioning authority, the Vestry has declined to accept the provisional sanctions of £10,000 and £38 000, in place of the £13,200 and £56,261 asked for.

SHOREDITCH.—The Finance Committee reported at a meeting of the Vestry on Tuesday, having under consideration the question of charging the capital and revenue accounts of the electric light undertaking with bank interest, in consequence of the large overdraft which had accumulated since March 25th, 1899. It appeared that the general rate account received the sums allowed for bankers' interest on the minimum aggregate fortnightly balances, and the same account paid the amount charged for interest on the overdrawn daily balances in respect of all the different funds of the Vestry, and in the opinion of the committee, that account should be credited with £1,333 for financing the electric lighting department. The committee accordingly recommended that the sum of £1 333 should be debited to the revenue account of the electric light undertaking, and credited to the general rate account. After discussion, the recommendation of the Committee was adopted. A letter was received from the Battersea Vestry intimating that at the conference recently held to consider the Bill promoted by the County of London and Brush Provincial Electric Lighting Company, the representatives of the local authorities present passed resolutions expressing the desirability that the authorities in the area affected should oppose the Bill. The Battersea Vestry suggested that a joint petition should be presented against the Bill, and the Vestry decided to co-operate with the former and other authorities in sealing the petition.

Londonderry.—A report on the electric lighting question has been submitted to the City Council by Sir W. H. Preece. The report is strongly in favour of municipal control, anticipating a connection of 30,000 lamps and a large power load in Londonderry. The question stands adjourned for further consideration.

Lynn.—The Town Council has resolved to apply to the Local Government Board for leave to borrow a sum of £10,000 for electric lighting purposes.

Malvern.—The ratepayers have unanimously decided at a public meeting not to carry out the scheme recommended by Mr. Hammond. This appears to be a case where the consulting engineer has told them what was unpalatable, and stuck to his guns, in spite of every temptation to whittle down the scheme. Mr. Hammond stated in his report that unless Malvern could support a £30,000 scheme, it would be impossible to establish electricity works on a paying basis. The report was referred back to the committee with the request to get the consulting engineer to cut it down to £10,000. Mr. Hammond refused, and hence his being relieved of the trouble of carrying out any scheme at all. The Malvern District Council has held the provisional order for 10 years, and it will probably find that the time has now arrived when the Board of Trade will not let it play with the order any longer.

Morecambe.—The Local Government Board has refused permission to a loan of £24,000 for electric lighting purposes on the ground that the District Council has reached the limit of its borrowing powers.

Neath.—The Town Council has decided to oppose the South Wales Electrical Power Distribution Bill.

Newport (Mon.).—The Town Council last week resolved to present a petition against the South Wales Electrical Power Bill, to be promoted in the ensuing session of Parliament.

Paisley.—The Electric Lighting Authority is applying to the Secretary of State for Scotland for leave to borrow £20,000 for electric lighting purposes. The present borrowing powers amount to £60,000.

Perth.—Last week the Commissioners decided to charge consumers for their supply of electricity on the Brighton system at the rate of 3d. per unit after 90 hours' consumption per quarter of the consumer's maximum demand, the first 90 hours of such consumption being charged at 7d. per unit; and to charge for energy supplied for motive power, heating, and cooking at the rate of 3d. per unit.

Rome.—The output of the Tivoli-Rome power transmission installation for the year 1899 amounted to no less than 2,500,000 units.

Sheffield.—The total revenue of the electric light undertaking for 1899 was £23,342, against £19,038 in 1898, and the cost of production £9,021 against £6 334. The net profit for the year was £91+. The output in 1899 increased 35·9 per cent., and the number of lamps 34·8 per cent., as compared with 1898.

South Bank.—The District Council is making inquiries into the question of obtaining powers for electricity supply.

Southgate.—The District Council has resolved to oppose the Bill of the North Metropolitan Electric Power Supply Company, under which powers are sought to supply electricity in this and other districts in the county of Middlesex.

Sunderland.—The Town Council has resolved to oppose the County of Durham Electric Power Supply Company's Bill now before Parliament, and to obtain leave to borrow £4,500 for the purchase of a site for the new electric supply station. A deputation from the Council is about to visit various electricity supply stations.

Swansea.—The Electric Committee of the Swansea Corporation has authorised the mayor, chairman, and town clerk to attend at Westminster on the occasion of the second reading of the South Wales Electric Power Distribution Company's Bill. What for?

Taunton.—The Electric Lighting Committee of the Town Council reports that the accounts of the electricity undertaking for the past year show a credit balance of £603, after paying all charges.

Tiverton.—The Town Council has resolved to appoint Mr. W. P. Adams consulting electrical engineer to the Council to prepare a report on the system of electric lighting to be adopted.

Tunbridge Wells.—An elaborate report has been drawn up by the borough electrical engineer, Mr. H. Boot, on the comparative qualifications of incandescent gas and electric lamps for street lighting, in which the experience of other towns with the former is outlined. It is shown that while about double the light is obtained, compared with ordinary gas burners, the candle-power of the mantles rapidly falls off, and they are liable to destruction by vibration, insects, bad weather, and in cleaning; the average number of renewals per annum being roughly about a dozen. On the other hand, about 90 British towns have increased or are increasing the number of their arc lamps, showing that satisfactory results have been obtained therewith. Lighting by glow lamps is also discussed, and it is stated that the same illumination as is offered by the gas company can be obtained for the same price, viz., £3 7s. 6d. per annum. The Lighting Committee having considered the report, has decided to erect 220 additional electric glow lamps in the side streets of the borough.

West Ham.—At last week's Town Council meeting it was reported that the Lighting and Tramways Committee had had considerable correspondence with Messrs. Drake & Gorham on the question of the contract for the arc lamps. The Council, on the advice of the consulting electrical engineer, rejected the lamps, and required the substitution of others. The contractors had issued a writ to recover the balance of the amount of their contract with an extra claim, totalling £1,514. The Committee recommended that the Council accept the lamps, and that the contractors be asked to take £1,049 in full settlement of all claims. The electrical engineer reported on the type of lamp and system which would be best for the High Street extension. He suggested that the enclosed system of lamp, such as was in use in the Romford Road, should be adopted, on account of the better distribution of light which it gave. Having made a practical test of the British Thomson-Houston Company's lamp, he strongly urged the Committee to adopt it, whereupon the Committee recommended the Council to purchase 25 series lamps at £355 net.

Patriotism in West Ham seems to be at a discount. At a meeting of the Town Council last week, it was proposed that half-pay and leave of absence should be granted to an assistant in the electrical engineer's department, who had volunteered to join the Electrical Company of the Royal Engineers, and to any others who might do likewise. The avowed supporters of their country's enemies succeeded in rejecting the proposal by 20 votes to 17, the labour party voting pro-Boer.

Yarmouth.—The statement of accounts of the electricity department shows a net profit for the last quarter of £376.

ELECTRIC TRACTION NOTES.

Bristol.—The controversy by correspondence between the Bristol Tramway Company and the Sanitary Committee has been carried a step further. It arose out of the reconstruction of the company's lines for electric traction and the arrangement with the committee that, if the company wood-paved their part of the road, the committee should do the balance. This the company complain the committee has neglected to do, and they allege they have suffered damage in consequence. On February 15th the city engineer wrote, at the instruction of his committee, that the committee intended to carry out not only the letter, but the spirit of their agreement with the company, and considered that by applying to the Local Government Board for sanction to do the work, and using their best efforts to obtain the necessary timber, they had done all in their power to give effect to the terms of the agreement of April 26th, 1899, "by which the Corporation undertook to pave the sides of certain streets simultaneously, as nearly as may be," with the company's works. The words, "as nearly as may be," the city engineer contends were inserted because both parties to the agreement knew of the unavoidable delays attending application to the City Council and the Local Government Board. "Whilst," said the city engineer in conclusion, "I do not consider your company can blame the Sanitary Committee for a delay not caused by them, I shall, without binding myself or them to any particular dates, proceed with the work at the earliest possible opportunity." The secretary of the company, in his reply on February 19th, disagreed with the explanation of the insertion of the words "as nearly as may be." The words were, he said, not specially inserted at all, but were part of the company's draft, and were intended to meet the difficulty of the tramway company's and the committee's workmen being in the street at the same time. The intention was for the Corporation workmen to follow the company's workmen as the tramway work proceeded. The reply referred to other points, and concluded: "I am now instructed by the directors to state that the subject is far too important to allow of their permitting it to remain in its present unsatisfactory position to the company's serious detriment, and they have requested the company's solicitors to deal with it."

London County Council.—The Parliamentary Committee reported, at a meeting of the Council on Tuesday, that the South-Eastern Metropolitan Tramways Bill had duly come before the examiner, who had informed the Select Committee on Standing Orders that the standing orders had not been complied with owing to the refusal of the County Council and certain road authorities to give their consents. In the opinion of the Committee the promoters intended to endeavour to obtain a suspension of the standing orders so as to admit of the introduction of the Bill. It was decided, on the recommendation of the Committee, to affix the seal of the Council to a petition to be laid before the Select Committee on Standing Orders asking that the suspension of standing orders in the case of the Bill in question should not be permitted. The Highways Committee reported the receipt from the engineer of the Baker Street and Waterloo Railway Company of plans showing proposed stations at Piccadilly Circus and Oxford Circus. It was decided to approve the plans of the former and disapprove those of the latter owing to the booking office accommodation being regarded as inadequate. It was resolved to approve plans submitted on behalf of the Whitechapel District Board for the erection of a generating station in Osborn Street, Whitechapel.

Mandalay.—The people of Mandalay have decided to make another attempt to introduce an electric tramway in their town. The scheme submitted by the Burma Electric Works Syndicate, Limited, whose agent in Mandalay is Mr. M. F. Kindersley, has, with some modifications, been accepted by the Mandalay Municipal Committee. The tramway is to be commenced within one year and completed within three years from the date of the order.

The Metropolitan District Railway and Electric Traction.—At the half-yearly meeting of this railway last week, Mr. J. Staats Forbes, the chairman, made the following remarks on the question of electrical working:—"With regard to the trials of electric traction which had been made upon the line, the directors said nothing in the report about the matter, because they felt it would be more satisfactory if he himself made a statement upon the subject. A report had been made to the directors by Sir W. H. Preece and by Sir J. Wolfe Barry. As in this case they were proposing to use electric traction under circumstances entirely different from those of the ordinary electrical railways, which were constructed in a special manner to be worked by electrical power, they themselves had a totally different problem, which was to adapt electrical power to a railway constructed for an altogether different locomotive power. That was not such an easy thing to do as some people might imagine, and, therefore, although the shareholders had given their sanction and the company had acquired Parliamentary powers, together with the Metropolitan Company, they thought it well before adopting the new traction to make experiments upon the line. This had been done, and the results had been reported to them by Sir W. H. Preece and Sir J. Wolfe Barry. These gentlemen intimated that they were perfectly satisfied that the essential factors had been determined, and that by electricity they could move a much larger weight than the weight of the company's ordinary trains. The capacity would be quite 500 passengers per train, as against 450, and that weight could be propelled more rapidly, with greater certainty, with much less exhaustion of time in either stopping or starting, and, they believed, more economically per train mile than in the case of the ordinary trains. That was the conclusion come to by Sir W. H. Preece and Sir J. W. Barry, who would shortly be prepared to satisfy any inquirer by tests upon the line. He, the chairman, thought the shareholders would agree that that was a very satisfactory statement to be able to make. Of course, they must not lose sight of the fact that, assuming electric traction was proved to be satisfactory, and it was adopted in the interests of the shareholders, it would cost more money, and the speculation was that the economy effected and the increased capacity in working would produce equivalent benefits and quite compensate them for the change. All this would be a matter of history three years hence, he had no doubt. They would then have to consider what was the position of the other companies which ran trains upon this company's lines. He supposed they, too, would have to be persuaded to use electricity. The shareholders were, of course, aware that there were three or four companies who had statutory running powers over this company's lines, and they were obliged to provide engines to this company's approval. He had thought it might be suggested that if the engine of the time were intended when that provision was made, it might again become subject, in course of time, to this company's approval in some other shape. At all events, he would proceed to raise the point, in practice, by suggesting that the time had come for those companies to put on an improved engine. He did not know what such large companies as the Great Western and the London and North-Western would say to that, but he thought

they might be persuaded to make the change if they were shown that it would be to their advantage to do so. All this, however, concerned the future."

In the House of Commons last week, in reply to Mr. Weir, Mr. Ritchie stated that substantial progress had been made with the experimental work on the District Railway, and that it was proposed to run a train for the conveyance of passengers between certain points on the line in the course of a few weeks.

Newport (Mon.).—A good deal of controversy has been aroused at Newport over the scheme of the Corporation to provide an electrical power station for the generation of electricity for traction and other purposes. The scheme will probably involve a very heavy outlay. A diversity of opinion exists as to the site for the new station. There are two main parties in the Corporation, one recommending a site at Crindau, and the other a site in the new district known as Corporation Road. The latter party appears to be more numerous, but it is understood that Lord Tredegar will oppose a site in the Corporation Road district. At a recent meeting of the Electricity Committee,

The committee proceeded to consider the report of the chairman, Councillor Llewellyn, upon the question of installing a traction and power plant alongside and in conjunction with the existing electricity works. In referring to the question, the chairman read a report by the borough electrical engineer, pointing out that there was ample room upon the existing site, without taking the waterworks yard, to place the whole of the machinery for traction, power, and light for very many years, and he recommended that in putting down additional plant for traction purposes, it should be interchangeable for lighting purposes, and be available for dealing with the lighting by continuous current of the whole of the area of the borough within a radius of half a mile of the works. The existing alternating plant would then be available for dealing with all the future extensions of the lighting outside the area referred to. He estimated that the cost of altering the lamps, meters, and transformers necessary for direct current in the half-mile radius would amount to about £1,200. These reports were discussed and considered, but no definite resolution was arrived at before the time fixed for a meeting of the Joint Committee (the Lighting and Traffic Committee and the Electricity Committee) appointed to recommend a site for the proposed power station.

The Council having referred to this Joint Committee the question of recommending a site, the reports of the Lighting and Traffic Sub-Committee, and of the chairman of the Electricity Committee, who visited other towns, were supplied to each member of the Committee for consideration. At a meeting of the Joint Committee, Mr. Councillor Llewellyn, the chairman of the Electricity Committee, read a further report from the borough electrical engineer which went to show that there was ample room alongside the present site for putting down sufficient plant for power purposes to cope with the demand for very many years, and recommended that the plant laid down should be capable of being used for traction or lighting, and that the lighting of that portion of the borough within a radius of half a mile of the electricity works should be worked from such new continuous current plant, and the existing alternating plant should be confined to the present and future lighting of the borough outside that radius. The whole of the reports having been considered, and the borough engineer and Mr. Parshall having stated their opinions upon the questions of obtaining coal and water and the foundations of the proposed site at Corporation Road, it was resolved that the Corporation Road site, as scheduled in the Bill of this session, be recommended to the Council as the only site to be adopted for the erection of a generating station for electrical traction and power purposes, car sheds, repairing shops, and tramway equipment.

The report of the Joint Committee was presented to the Town Council on Tuesday last week by Councillor Brown, who said that Mr. Parshall, the expert engineer who they had called in, was strongly in favour of the Corporation Road site.

Mr. Parshall submitted a report on the question of the electric station. A deputation visited various places (including Liverpool, Dublin and Cork), and saw the power stations there. The reports were favourable to a separate power station, apart from the lighting station located in Friars Fields. Mr. Parshall's report was favourable to the Corporation Road site. Would the expert's opinion be now thrown over? An area of about 5 to 6 acres was required where car sheds and workshops could be erected. The Corporation Road site was the only one which answered all requirements. At the present electric light station there is about an acre available for extension purposes. It was said that if the Corporation Road site was fixed upon, Lord Tredegar would oppose it. He did not think that when his Lordship considered the matter there would be opposition from him, but under any circumstances the interests of the town should claim pre-eminence. He proposed the adoption of the Joint Committee's report.

Councillor Collier seconded.

The Council ultimately went into committee on the matter, and the Press retired, it being understood that a report on the matter would be made at the next month's meeting of the Council.

We understand that the result of the meeting of the Council in committee is that the three sites, viz., Friars Fields, Crindau, and Corporation Road, will be scheduled on the Council's Parliamentary Bill, and sanction for all three will be sought, thus leaving the Council alternative sites.

Sheffield.—Mr. A. L. C. Fell, electrical engineer to the Sheffield Corporation, has returned from Berlin, where he has made an inspection of the generator which has been constructed there by the British Thomson-Houston Company for the Kelham Island power station. The engine with which the generator will be built up is being made by English contractors, and a separate test of the generator before shipment to this country was considered advisable.

It is likely that in the near future an improved life-guard will be in use on the electric cars in the city. The Tramways Committee has been considering the question for some time, and we hear that an appliance has been hit upon which will be more satisfactory than the wirework fender at present in use. Steps are being taken to have the guard patented.

South Essex.—On Saturday the Ilford District Council received official sanction from the Local Government Board for borrowing powers for the installation of electric light and electric tramways. The West Ham Town Council and the East Ham and Leyton District Councils have also similar schemes in hand, and when the various projects—some of which are already commenced—are completed, a network of municipal electric trams will extend over the major portion of South Essex—from Seven Kings, through Manor Park, East Ham, Forest Gate, Upton, Plaistow, Canning Town, Stratford, and Leytonstone and Leyton.

Southampton.—At a Town Council meeting last week the Electricity and Tramways (Joint) Committee reported that they had decided that the Electricity Committee should undertake the maintenance of the entire electric equipment of the tramways at a charge of ¼d. per Board of Trade unit sold to the Tramways Committee; and, further, that the Electricity Committee provide a man to attend at the tramway depôt during the hours of running the cars. The maintenance to include all ordinary repairs to car equipment and renewal of car lamps and overhead work, but no other renewals, and the necessary staff for the carrying out of this work to be supplied by the Electricity Committee. Alderman Bone, in moving the adoption of the report, said the Committee thought the arrangement a very fair one. They thought it necessary that the electric equipment of the cars should be under the electrical engineer in connection with the electric supply. The report was adopted.

Surrey Light Railways.—The Surrey County Council have decided to abandon their comprehensive scheme of light railways for Kingston, Surbiton, Richmond, Barnes, Wimbledon, &c., in consequence of a resolution passed at the last meeting to the effect that such undertakings had better be left in the hands of local authorities.

Wirral Electric Railway Bill.—In the above Bill we read, among other provisions, the following:—"The lands for the proposed generating stations are situated between the Birkenhead Docks Station and Bidston Station; also the triangular piece of land formed by the junction of the New Brighton branch railway with the Seacombe branch railway, and also adjoining Meols Station. The system of electricity adopted is similar to that of the Liverpool Overhead Railway, with carriages on the same pattern; and by a more frequent and accelerated service of trains, which electricity makes essential if it is to become profitable, the future success of the company is looked forward to with the most sanguine expectations."

Wolverhampton.—Sir Frederick Bramwell sat at Wolverhampton on Tuesday to hear evidence (as the arbitrator appointed by the Board of Trade) to enable him to determine the price to be paid by the Corporation for so much of the undertaking of the Wolverhampton Tramways Company as lies within the borough boundaries. After the hearing had proceeded for some time, it was announced that an amicable arrangement had been come to by which the company agreed to sell, and the Corporation to purchase, the undertaking at the sum of £22,500, together with costs. It was stated that the amount thus agreed upon is about one-half the sum which the company fixed upon about two years ago: and about a third less than the sum the company hoped to obtain when they entered the arbitration room.

TELEGRAPH AND TELEPHONE NOTES.

Electrical Communication with Lighthouses.—In the House of Commons last week Mr. Charles M'Arthur asked the President of the Board of Trade whether it was intended to give effect to Clause 2 (5) of the Mercantile Marine Fund Act, 1898, which provided that in so far as might be compatible with the efficiency and safety of the lighthouse service telegraphic communication with lighthouses should be available for private messages at reasonable charges, and if such was the intention, when he would be in a position to state the terms and conditions upon which these facilities would be granted.

Mr. Ritchie replied: The question how far electrical communication with lighthouses may be made available for private messages is one of the points which have been referred to an Inter-Departmental Committee, who are dealing with the whole subject of communications between lighthouses or light vessels and the shore. Until I have received the report of that Committee I shall not be in a position to give the information asked for by the hon. member.

Imperial Cable Communication.—The *Times* Melbourne correspondent, writing on 15th inst., says that the Victorian and New South Wales Governments have agreed to accept the Eastern Extension Company's proposals to lay a direct cable between the Cape and Australia, and considerably to reduce the present charges, on condition that the company is allowed to open its own offices in the principal cities for the receipt and despatch of messages.

No contract has been signed, but the following terms have been practically accepted:—

The Australian military authorities are to be consulted as to the landing site of the shore ends of the cable. The company having reduced its charges, cannot again raise them. The company is to be allowed to open local offices as soon as the Pacific cable or any other competing cable has been laid; meantime the reduced charges are to take effect three weeks after the contract has been signed.

In the Victorian Legislative Assembly Mr. Duffy and Mr. Gillies challenged the arrangements on the ground that they would injuriously affect the Pacific cable, which the Colony was pledged to support. Mr. Watt, the Postmaster-General, replied that the Government intended to adhere fully to the obligations of Victoria to support the Pacific cable, but wished meantime to give the public the advantage of cheaper cable rates.

The Ottawa correspondent of the same paper telegraphed on February 19th:—Canada is unalterably opposed to any concessions

to the Eastern Extension Company. The Melbourne despatch in the *Times* of Saturday was read in the House of Commons to-day by Mr. Casey, who stated that if the privileges mentioned in the telegram were granted to the company the Pacific cable project would be seriously injured. Sir Charles Tupper said that at the moment when a partnership was entered into between the British Government and the different colonies regarding the construction of the Pacific cable it was not legitimate for either Great Britain, Canada, or Australia to alter the *status quo* by any concession to the Eastern Extension Company which would militate against the financial success of the project.

Mr. Mulock said the question was of far-reaching importance to the whole Empire. The Government held the view that if the suggested concessions were granted to the Eastern Extension Company, they would endanger the success of the Pacific cable project. The moment the Eastern Extension Company got a footing in Australia they would practically secure the control of the cable business. The company would acquire interests and would influence public opinion in such a way as might lead the Australian Governments to ask for the postponement of the Imperial project. The Dominion Government felt that delay involved the defeat of the entire scheme, and they took the same view as Sir Charles Tupper that the colonies were partners in the project. There should not be the slightest alteration in the conditions without the consent of all. The Eastern Extension Company, with great astuteness, sought to have its application dealt with at headquarters in London. Canada strenuously objected to this, and within the last 48 hours telegrams had been sent to the Imperial and Australian Governments embodying the views of the Dominion.

A Reuter despatch from Ottawa says that the Canadian Government was again closely questioned on the 20th inst. in the House of Commons as to whether the Imperial Government were consenting to concessions by Australia to the Eastern Extension Cable Company. In the course of a long and somewhat animated debate, some members called in question the sincerity of the Imperial Government in the scheme. Mr. Mulock, the Postmaster-General, assured the House that the Government had no information justifying such a conclusion, and was satisfied that the allegation was without foundation. An uneasy feeling is evidently arising among the public prejudicial to Imperial sentiment, considering Canada's action in regard to the war in South Africa, that the Imperial Government has failed heartily and actively to promote the Pacific cable scheme.

In the House of Commons on Tuesday, Sir E. Sassoon asked the First Lord of the Treasury whether Her Majesty's Government will consider the desirability of withholding their sanction from future agreements between the Eastern Telegraph Company and the subsidiary companies and the Cape, Indian, and Australian Governments until Parliament had had an opportunity of taking cognisance of them; and whether, if the Government had no control over those conventions so far as regards the Colonies, Her Majesty's Government would point out to the Colonial Governments concerned the expediency of abstaining from any final decision until an Imperial policy of a comprehensive nature, embracing Colonial interests, had been formulated by Parliament in the course of this session.

Mr. Balfour, in reply, said: I think my hon. friend will see that the matter to which he calls attention in this question is one which cannot really be dealt with by the Imperial Parliament alone. It is a matter for negotiation between the self-governing Colonies and the Home Government.

Also in reply to Sir E. Sassoon, Mr. Chamberlain said:—The question of the arrangements for constructing and laying the Pacific cable is under the consideration of a committee, on which the Imperial Government and the colonies interested are proportionally represented, and Her Majesty's Government understand that the deliberations of the committee will soon be completed. The committee is aware of the state of the market for cable materials.

Glasgow Telephones.—The *North British Daily Mail* says that the Glasgow committee in charge of the telephone scheme had a meeting with their engineer, Mr. Bennett, last week. It is expected that a complete installation of telephones will be in working order within the next 12 months. The service will be an independent one, and the system adopted is the twin-wire underground. The committee are said to be confident that, if they can supply this improved method for 5 guineas a year instead of £10, which is the rental at present, they will soon have a larger number of subscribers than the Telephone Company now has.

Overhead Wires in the City.—The *City Press* says that the Corporation is taking action with a view to safeguarding the public against the dangers of overhead wires in the City. A notice has been published warning the owners of all wires, supports, and attachments to place identifying marks upon them in accordance with the London Overhead Wires Act, 1891. If the work is not completed on or before Thursday, 1st prox., they will be removed. The penalty of failing to comply with the demand is £5, with a further penalty not exceeding 40s. for each day the offence is committed after a conviction is recorded. Details and specimens of the identifying marks must be sent to the town clerk (Sir John B. Monckton) without delay. The Corporation has only just recently appointed an inspector, who, we are informed, has failed to discover any distinguishing marks; indeed, in this particular the identifying clues are conspicuous by their absence. The late Commission of Sewers never grappled with the difficulty, as the question of underground wires loomed large in the future, and, consequently, the provisions of the Act do not seem to have been enforced within the City. The Corporation, however, possesses full powers to deal with overhead wires, and, if the Act is not carried out within all reasonable limitations, the offending wires can be cut, and communications destroyed. Such an extreme measure is not likely to be taken by the Corporation at the present juncture, but certainly it is high time that the owners of overhead wires should realise their responsibilities.

Pacific Cables.—The *Standard* Berlin correspondent says that the German Government proposes to extend the cable which is to be laid by the United States across the Pacific, to German Island, and thence to Kiao-Chau. The necessary expenditure will be provided for by a Supplementary Credit.

Reuter's Agency is informed that the Agent-General for New Zealand, under instructions from his Government, has handed in a letter to the Colonial Office expressing very strong objection to the concessions asked for by the Eastern Telegraph Company, on the ground that they would militate against the success of the Pacific cable, to the construction of which the New Zealand Government holds itself fully committed.

At the Colonial Office on Tuesday the Pacific Cable Board held its third meeting. Sir Francis Mowat presided, and there were seven other members present. Lord Aberdeen addressed the meeting, and there were signs that the labours of the Board would terminate much sooner than those interested in this project had reason to expect.

Telegraphic Breakdown.—It is stated that at about mid-day on Wednesday last week the City cable companies suddenly stopped working. On investigation it was found that a Post Office man, repairing wires at the corner of Queen Street, Cheapside, had by some means upset a naphtha lamp and set fire to the whole exposed gutta-percha lines, of which there were 300. The man had to cut his way out through the canvas screen, and every wire was burned out. Great difficulty arose in repairing, owing to the leaden tablets bearing the numbers of the lines being melted and destroyed. The cable companies suffered great inconvenience, and at one o'clock very few had got through. The Eastern, Great Northern, and all the Atlantic companies suffered badly. There was not a single wire to the Stock Exchange, and had it not been for the pneumatic tubes the members would have suffered much more inconvenience.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
WEST INDIES:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1891 duplicate)	Oct. 23, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Cayenne-Paramaribo ...	Feb. 16, 1900 ...	...
Ceara-Maraham	Feb 20, 1900 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Majunga-Tananarive ...	Feb. 9, 1900 ...	...
Tarifa-Tangier	Jan. 2, 1900 ...	...
LANDLINES.		
WEST INDIES:—		
Communication with Port de Paix (Haiti)	Feb. 20, 1900 ...	...
SOUTH AFRICAN:—		
Communication with Mafeking and beyond	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River ...	Oct. 18, 1899 ...	...
Communication with north of Mooi River (Natal) ...	Oct. 22, 1899 ...	...
Communication with Colombia	Oct. 23, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	Feb. 8, 1900
Communication with all towns of United States of Colombia beyond Buenaventura	Jan. 22, 1900 ...	...
Communication with Rome-Pera beyond Vallona	Feb. 15, 1900 ...	...
Saigon-Bangkok	Feb. 7, 1900 ...	Feb. 8, 1900
"	Feb. 12, 1900 ...	Feb. 13, 1000
"	Feb. 16, 1900 ...	Feb. 16, 1900
"	Feb. 19, 1900 ...	Feb. 19, 1900
Serena-Valparaiso	Jan. 16, 1900 ...	...

Wireless Telegraphy.—The *Morning Post* says that Mr. Long, Secretary of the United States Navy, is of opinion that no system of wireless telegraphy of any practical value has yet been devised, and he has consequently decided against the present adoption of it in the American Fleet. At the same time experiments are being made on the other side of the Atlantic with a system which is said to be very simple, and the Trinity House is said to have been offered another method. Meanwhile a number of experiments are to be carried out by the officers of the *Vernon* at Portsmouth with the object of establishing wireless telegraphic communication between a ship at sea and the shore by means of a balloon. It is perhaps not generally known that the Admiralty has by no means abandoned the system of its own, and that this system is being gradually improved and perfected.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—February 28th. The Tramways Committee wants tenders for four electrically-equipped tramcars. See our "Official Notices" February 9th.

Birkenhead. — March 1st. The Corporation wants tenders for the supply and laying of feeder and distributing mains. See "Official Notices" February 9th.

Blackburn.—February 26th. The Corporation wants tenders for feeder cables for electric traction. See "Official Notices" February 16th.

Durban (Natal).—April 2nd. The Corporation is inviting tenders for 1,900 tons of steel girder rails, 64 tons of fishplates (bolts, bonds, &c.), 407 loads Australian hardwood stringers, &c, also the laying of same for 14·36 miles of single track, and bonding 2·96 miles of equivalent existing single track, the Corporation laying concrete foundations and making up roadway. See "Official Notices" February 9th.

Edinburgh.—March 5th. The Corporation wants tenders for the extension of the electric lighting at Shrubhill tramway power station. See "Official Notices" to-day.

Farnworth.—March 7th. The Urban District Council invites tenders for Lancashire boilers, economisers and other steam plant, three 120-kw. steam dynamos, lighting and traction switchboards, accumulators, underground cables, travelling crane, and re-cooler tower. See "Official Notices" February 16th.

France.—March 8th. The French Post and Telegraph authorities in Paris are inviting tenders until March 8th for the supply of 229 kilometres of gutta-percha insulated electric cable in six lots. Particulars may be obtained from, and tenders are to be sent to, Le Sous-Secretariat Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Germany.—February 28th. Tenders are being invited until the 28th inst. by the Prussian State Railway authorities at Hanover, for the supply of 27,000 porcelain insulators, four tons of insulated wire, and 224 tons of telegraph wire. Tenders are to be sent to Die Königliche Eisenbahn Direction, 7, Joachimstrasse. Hanover, whence particulars may be obtained on payment of 61.

Germany. — March 2nd. Tenders are being invited until March 2nd by the Prussian State Railway authorities at Cologne for the supply of 74,350 porcelain insulators, 19½ tons of copper-bronze wire, 6½ tons of insulated wire, and 258 tons of galvanised iron wire. Tenders marked "Angebot auf Lieferung von Telegraphen materialen" are to be sent to Die Königliche Eisenbahn Direction, 28, Domhof Erdgeschoss, Cologne, whence particulars may be obtained.

Gloucester.—February 27th. The Corporation invites tenders for the wiring of the Guildhall, public baths and electricity works, also the necessary fittings. See "Official Notices" February 9th.

Horsham.—March 1st. The Urban District Council is wanting tenders for water-tube boilers, pipework, two steam dynamos, batteries, switchboard, 6-ton overhead traveller, mains, road work, enclosed arcs, and station lighting. See "Official Notices" January 26th.

Lancaster.—March 22nd. Tenders are wanted for three Lancashire boilers, superheaters, economiser; three 175-B.H.P. steam dynamos, booster, switchboard, pumps, cranes, &c.; accumulators; feeder mains (solid system); and wiring of buildings, all for electric lighting purposes at the Rainhill County Asylum. Particulars will be found among our "Official Notices" in this issue.

Leeds.—March 21st. The Tramways Committee wants tenders for one, two, or three steam dynamos. See "Official Notices" to-day.

Melbourne.—March 1st. The Corporation is wanting tenders for boilers, engines, dynamos, switchboard, feeders, mains, arc light leads, accumulators, &c., for electric lighting. See "Official Notices" December 22nd.

Newcastle-on-Tyne.—March 2nd. The Tramways Committee wants tenders for 130 car bodies, trucks, and electrical equipment for same. See "Official Notices" February 2nd.

Poplar.—March 1st. The Board of Works is prepared to consider schemes for fitting up consumers' houses for electric lighting, free of initial cost to the Board or consumers. See "Official Notices" February 16th.

Rochdale.—February 28th. The Corporation wants tenders for electricity meters. See "Official Notices" February 2nd.

Salford.—February 28th. The Corporation wants tenders for electrically-driven mechanical stokers, economisers, jet condensers, and pumps, with steam exhaust and water pipes, electrically-driven feed pumps, feed pipes, and travelling crane for their new electricity works. See "Official Notices" February 9th.

South Shields.—March 12th. The Corporation wants tenders for high and low tension cables and ducts. See "Official Notices" to-day.

Sunderland.—March 2nd. The Corporation wants tenders for the supply of steam, exhaust, feed and other pipes, and two steam-driven induced draught fans and accessories. See "Official Notices" February 9th.

Walthamstow.—February 23rd. The District Council wants tenders for the supply of electric lighting and Dowson gas plant at the Isolation Hospital, Chingford. See "Official Notices" February 2nd.

Wigan.—March 3rd. The Corporation wants tenders for steam piping, feed pumps, circulating pumps, feed water heaters, piping, &c., for electricity works. See "Official Notices" to-day.

Wimbledon. — February 26th. The District Council wants tenders for 25 lamp-posts for incandescent electric street lighting. See "Official Notices" February 16th.

CLOSED.

Bradford. — The Electricity Committee has decided to accept the tender of Messrs. Siemens Bros. & Co., Limited, to supply an additional armature for a 600-H.P. dynamo at the Valley Road Electricity Works.

Glasgow.—The Corporation have accepted the tender of Messrs. D. Bruce Peebles & Co., for three 350-H.P. generators direct coupled to Willans engines for the contract price of £7,500.

Glasgow. — Mr James White is to supply two sets of feeder panels, &c., for the switchboard at Port Dundas Electric Station at £3,219 14s. 10d. The Electric Construction Company, Limited, are to provide electric motors for elevators at the Pollokshaws Road Station at a cost of £170 15s. each.

Hackney.—The Hackney Vestry, at their meeting on February 14th, had under consideration the report of their consulting engineer, Mr. Robert Hammond, on the tenders received for the accumulators required for the municipal electricity works. The following is a list of the tenders received; that of the Tudor Accumulator Company, Limited, for £7,665, being accepted:—

The Tudor Accumulator Company	£7,665
The D.P. Battery Company	8,733
The Electrical Power Storage Company	9,918
The Hart Accumulator Company	10,823
The Chloride Electrical Storage Syndicate	12,567

London.—The Bermondsey Vestry have accepted the tender of Messrs. Hughes and Stirling, amounting to £10,242, for the supply of a six-cell refuse destructor, in conjunction with the electric lighting station. The criticisms of the consulting engineers, which we hope to print in our next issue, will be of considerable interest to makers and others concerned with the problem of refuse destruction, more especially as the publication of the views of consulting engineers on rival destructors is a matter of infrequent occurrence.

Sunderland.—The Town Council has accepted the tender of Messrs. Moon, Loughlin & Co., for a traction switchboard.

Tunbridge Wells. — An order has been given to the Klein Engineering Company to erect at the Corporation electricity station, a combined condensing and Klein's water cooling plant for engines of 1,900 H.P.

FORTHCOMING EVENTS.

Friday, February 23rd.—At 5 p.m. Physical Society. *Agenda:* Prof. R. W. Wood, of the University of Wisconsin, U.S.A., will exhibit and describe his: 1. Photographs of sound waves and the kinematographical demonstration of the evolutions of reflected wave-fronts. 2. A new sondoscope. 3. Diffraction colour-photographs. 4. Artificial parhelia.

At 8 p.m. — Institution of Civil Engineers. Paper on "Bearing Springs," by B. Humphrey, Stud.Inst.C.E., and H. E. O'Brien, B.Sc. (Victoria), Stud.Inst.C.E.

At 8 p.m.—Electro-Harmonic Society Concert, Ladies' Night, Café Monico.

Saturday, February 24th.—At 7.30 p.m. Manchester Society of Junior Electrical Engineers, at the Deansgate Hotel, Manchester. A paper will be read by Mr. A. Rothwell, Assistant Engineer and Surveyor to the Radcliffe District Council, on "Destructors and their Application to Electric Light and Power Stations," illustrated with lantern, drawings, and model of a modern destructor.

Tuesday, February 27th.—At 8 p.m. Northern Society of Electrical Engineers, Grand Hotel, Manchester. Annual general meeting, presidential address, &c.

At 8 p.m.—Institution of Civil Engineers. Paper on "Corrosion of Marine Boilers," by John Dawrance, M.I.C.E.

Wednesday, February 28th.—At 8 p.m. Society of Arts. Prof. Carus-Wilson on "The Pneumatic Dispatch."

Thursday, March 1st.—At 8 p.m. Meeting of the British Association of Draughtsmen (Manchester branch), at the Deansgate Hotel. A paper on "Electric Traction" will be read by Mr. R. C. Walker, member. All information can be obtained by those interested, from Mr. W. E. Butcher, 209, Gt. Cheetham Street, Manchester, hon. sec.

Friday, March 2nd.—At 8 p.m. Institution of Junior Engineers, at the Westminster Palace Hotel. Paper on "Electrolytic Zinc as a Protective Metallic Coating for Iron and Steel," by Mr. William Paddon, of Wrexham, member

Special meeting of the Physical Society, in the Physical Laboratory of University College, Gower Street, by the kind invitation of Prof. Callendar. Agenda:—(1) "The Relative Rates of Effusion of Argon, Helium, and some other Gases," by Dr. F. G. Donnan; (2) "On the Distillation of Liquid Air and the Composition of the Gaseous and Liquid Phases," by Mr. E. C. C. Baly; (3) "The Reversibility of Galvanic Cells," by Mr. T. S. Moore; (4) "On the Damping of Galvanometer Needles," by Mr. M. Solomon.

Saturday, March 3rd.—At 3 o'clock. Royal Institution. Lord Rayleigh delivers the first of a course of six lectures on "Polarised Light."

At 2.30 p.m.—Institution of Electrical Engineers. Students' visit to Waterloo and City Railway.

At 3 p.m.—Institution of Junior Engineers. Visit to Messrs. Maudslay, Sons & Fields, Belleville Boiler Works, East Greenwich.

Electrical Engineers Volunteers' send-off dinner (see "Correspondence" columns this week).

Tuesday, March 20th.—At 4.30 p.m. Society of Arts (Foreign and Colonial Section). Sir Edward A. Sassoon, Bart., M.P., "Imperial Telegraph Communication."

Wednesday, March 21st.—At 7 p.m. Institution of Civil Engineers. Annual Dinner, Merchant Taylor's Hall, Threadneedle Street.

THE SOCIÉTÉ DES ELECTRICIENS.

THE monthly meeting of the Society took place in Paris on February 7th. First the President announced the death of Prof. Hughes, who left to the Society a sum of 50,000 francs.

M. Bochet then made some observations on arc lamps working at low voltage—discussed before. He remarked that with these lamps a saving can be realised by working them three in series on 110 to 120 volts. But it is necessary to use carbons of superior quality. He quoted the researches of M. Blondel, which have shown that the photometric efficiencies of low voltage lamps were lower than those of lamps working in the ordinary way, two in series on 110 volts. But these researches date as far back as 1897, and since that time great progress has been made in the manufacture of carbons. M. Bochet mentioned several installations, and particularly the railway at Sceaux, where three arc lamps have been used on 120 volts. But these lamps were well maintained and looked after, and arc lamp carbons of a superior quality used. He concluded by saying that all arc lamp systems allow of being worked with a reduced difference of potential, but special carbons are required. As a rule, it is also necessary to leave a margin between the total difference of potential and the difference of potential at the terminals of the lamps.

M. G. Roux then explained that in private installations, where a difference of potential of 115 to 120 volts was available, he was able to obtain good results with three lamps working in series. He also mentioned an installation in the Clichy sector comprising four groups of three lamps in series, and one of two lamps in series, in which all the lamps worked perfectly.

Lastly, M. Brillié added that he was able to work five lamps in series on 220 volts. For intensities higher than 8 amperes it is not necessary to have special carbons, but below this intensity the carbons must be tested and selected.

M. Vedovelli then submitted some high tension apparatus. The first instrument was a circuit-breaker designed by Mr. Still and provided with a mica screen. As soon as the breaker has begun to open the circuit this screen is introduced into the arc and cuts it. The apparatus enables 50 amperes to be cut at 6,000 volts. The arc can also be cut by stretching it to its utmost limit. To affect this, he has arranged two vertical rods of zinc which he has then brought together in the form of a V, leaving a space at the lower end. The arc is formed at the bottom and mounts towards the top, where it is broken. For 6,000 volts the space between the two rods at the bottom is 6 centimetres, and the length of the rods 50 centimetres. For 10,000 volts rods 70 centimetres long would be required, with a space of 10 centimetres at the bottom. M. Vedovelli also showed an oil circuit-breaker by Mr. Still, and concluded by describing apparatus for transformers for connecting to earth when contact is made between the primary and the secondary circuit. This apparatus consists of two metal plates separated by a sheet of mica, the thickness of which is determined according to the voltage to be attained. This sheet of mica is pierced with holes, and an arc is formed between the two metal plates at the determined voltage. For 400 volts the thickness of the sheet of mica is ·2 millimetre.

HOMES FOR DISCHARGED SOLDIERS.

THE BUILDING TRADES' GIFT.

Electrical Section.

CONTRIBUTIONS in kind towards the electrical equipment of the six homes, for which the detailed specifications were given in our issue of the 2nd inst., will be gratefully acknowledged by the honorary steward, Mr. Max Byng, of 69, Queen Victoria Street, E.C.; while the honorary treasurers, Messrs. H. Alabaster, Gatehouse & Co., of 4, Ludgate Hill, E.C., will be glad to receive cheques in aid of the gift.

We welcome the new additions to the list, and hope to see many more contributions to this most worthy object.

LIST OF DONATIONS TO DATE.

The ELECTRICAL REVIEW £26 5 0
Messrs. E. L. Berry, Harrison & Co., electric light contractors, Whitcomb Street 5 5 0
Messrs. W. J. Furse & Co., Nottingham—Fittings and labour to fit three homes with lightning conductors.
The Newton Electric Engineering Company, Taunton—One 12½-KW. dynamo.
Messrs. Rushleigh, Phipps & Co., Oxford Street, electric contractors—Labour for wiring one home.
Messrs. T. Clarke & Co., Sloane Square, electric contractors—Labour for wiring two homes.
Alley & McLellan, Glasgow—Two 50-H.P. engines at half cost price.
Mr. G Braulik, Upper Thames Street—Electric light fittings and switches.
The General Electric Company, Limited, Queen Victoria Street—Switchboards, cut-outs, ceiling roses, and switches.
Edison & Swan United Electric Light Company, Limited, Queen Street—Lamps and lampholders for the six homes.
Worthington Pumping Engine Company, Limited, Queen Victoria Street—The feed-water pumps required.

NOTES.

Obituary.—There has passed away a link with the past in the person of Mr. William Watkins, who has just died (February 10th) at Ladywell Park, Lewisham, and who had been connected with telegraphy since its introduction in England in 1837. He was born in 1823, and in 1836 he was a boy in Sir William Fothergill Cooke's garden, and assisted him in all his early experiments. In 1844 he was employed in the construction of the first permanent line of poles and wires erected to Portsmouth for the Admiralty and the London and South-Western Railway. He remained as inspector of that line in the service of the Electric Telegraph Company, and in 1870 he was pensioned by the Post Office, and passed into the service of the South-Western Railway Company, from which he retired on April 13th, 1899. He was quite an historical figure on the South-Western line, and was a very fine specimen of his class in appearance, feeling, and character. He was very much respected by everyone. He was on Sir William Preece's staff from 1856 to 1870, and on Mr. Goldstone's from 1870 to 1899. He thus reckoned 63 years continuous service in telegraphy.

Reaping the Whirlwind.—A "private circular" has reached our hands, in which is embodied one of the most outrageous attempts to get something—in cash—for nothing that we have ever met with. Primary battery "plants" are nowhere in comparison with the sublime impudence of the scheme of which we speak. The circular, a kind of prospectus, sets forth a so-called invention for "obtaining power from air currents in moving trains." The invention consists in mounting upon a truck attached to a railway train a wind engine, whose vanes are so exposed as to catch the air currents due to the motion of the train. The wind engine is to drive a dynamo so as to charge accumulators. The chief cost of production of the energy is said to be the freightage of one waggon, while every express train offers 100 H.P. or more of free energy (*sic*). As the average charge of supply companies is said to be 7½d. per unit, a very large margin of profits is promised. We need not go further into this exhibition of folly. To crown all, a quotation from Lord Kelvin is made use of, referring to the employment of wind power for charging accumulators. But even Satan can quote Scripture when it will serve his end.

Electric Fans v. Coolies.—The Punkah coolies in the Calcutta High Court have had to make way for electric fans.

"Earthed Outer" and "Armoured Wiring Systems."—As we go to press the following letter comes to hand from Mr. F. Bathurst:—"Even if your correspondent, Mr. Zingler, may feel satisfaction at having 'drawn' me, I regret that I am at the moment so much 'otherwise engaged' I cannot give him the opportunity of 'quartering' me. It will be better for both of us to continue to 'live and learn'; for my part I will try and fathom the necessity of running two bare wires on different circuits in the *same* insulated tube, instead of taking (as I do at present) two separate wires and tubes of smaller diameter from the nearest distribution board; but will Mr. Zingler carefully read and 'digest' Mr. Chamen's recent Glasgow paper and satisfy himself, amongst other points, as to the general undesirability of 'bunching' conductors? Whilst we are each trying to help it forward, we must both wait for the 'wiring millennium,' but the active and inquiring mind of your correspondent may, I suggest, find some 'profit,' if he will experiment with concentric 'tube' as distinguished from 'wire' systems, and discover, to his own satisfaction, that the former possess certain definite advantages in respect to mechanical strength and facility (perfection) of erection. If, at the same time, he considers such side questions as the 'use and limitations' of fuses, &c., he will, figuratively speaking, come to the conclusion that a cat may have to be killed in more ways than one, and that the insulation of a wiring conductor can be better secured by keeping the insulation *around* the wire rather than directly *upon* it."

Personal.—Mr. Fredk. Theodore Eggers has resigned his position as managing director and secretary of the British Schuckert Electric Company, Limited, and he is no longer connected with that company. Mr. Arthur George Seaman has been appointed manager, and Mr. H. J. Clement Wells secretary, to the company.

Owing to the death of his brother, which, as we have already stated, followed as a consequence of an accident in the hunting field, Mr. C. E. Hodgkin has been compelled to resign his position as works manager at the Falcon Works of the Brush Electrical Engineering Company, Limited. On terminating his duties at Falcon Works, Mr. Hodgkin will join the board of the Brush Company.

Parliament and the Power Schemes.—We read in Tuesday's *Times* that a meeting of Welsh Liberal members was held in one of the committee rooms of the House of Commons on Monday, to consider their attitude towards the South Wales Electrical Power Distribution Company's Bill, in view of the resolutions hostile to the measure passed at the recent conference of local authorities affected by the scheme. Mr. Alfred Thomas, the chairman of the Welsh Liberal party, presided; and amongst those present was Sir William Harcourt. It was decided to support the motion for the rejection of the Bill, of which Sir J. Dillwyn-Llewelyn has given notice for the second reading stage; and it is understood that Sir William Harcourt will take part in the debate. The main ground upon which the measure is opposed is that, Parliament having authorised the Corporations of Cardiff, Swansea, and Newport to borrow money for establishing electrical supply undertakings on the security of the rates, special powers ought not, in the interest of the community, to be granted to a company trading for profit to execute work of a similar character within the areas controlled by these Corporations, or to enter into competition with them. It appears that the area over which powers are sought by the Bill contains 1,087 square miles, and comprises the whole of Glamorganshire and the most populous parts of Monmouthshire. Three Bills on kindred lines, relating to Lancashire, Durham, and Tyneside respectively, being also before Parliament, it has been arranged that all four shall be put down for second reading at the same sitting, the date provisionally arranged being March 1st. As the same general arguments apply in each case, one discussion will, in these circumstances, suffice, and the fate of the measure which happens to stand first on the list will determine that of the other three. It may be noted that last year Parliament refused powers similar to those sought by the present Bills in two cases. In the course of the debate on the General Power Distributing Company's Bill, which was thrown out on the motion for second reading, Mr. Ritchie said:—

> It seemed to me the principle of the Bill was a direct attack upon the rights, privileges, and duties of municipal corporations, and whatever might have been the contingent advantages which might accrue in consequence of the passage of this Bill, I should have been bound to tell the House I did not think it would be wise in passing a Bill which practically set aside the existing law which adequately protects corporations in the exercise of the duties which they have to discharge. Any private Bill of that kind setting aside rights which corporations have by law ought to be rejected.

Mr. Galloway, M.P., has given notice that he will propose that on the second reading of three of the Electric Power Bills that stage of the measures should be postponed for six months. These motions relate to the County of Durham Electric Power Bill, the South Wales Electrical Power Distribution Bill, and the Tyneside Electric Power Bill. Sir John Dillwyn Llewelyn has also given notice for a motion of a similar kind in connection with the South Wales Bill. The action of the House on these Bills will govern its action in relation to the Lancashire Electric Power Bill. The promoters of that measure have, however, taken the precaution to introduce it in the first instance in the House of Lords, in the hope that if the Committee of the Upper House pass the Bill the Lower House may hesitate before it rejects it on principle. It is understood, says a correspondent of the *Manchester Evening News*, that the final action of Parliament on this class of measure will very much depend upon the report of the Joint Committee on Municipal Enterprise, which is to be appointed during the present session.

The Association of Municipal Corporations met in London on Monday to consider what course should be adopted to oppose the various electric power Bills now before Parliament. It is stated that all the local authorities in the country will petition their members of Parliament to strenuously oppose the Bill on second reading.

The Electrical Engineers (R.E.) Volunteers.—In connection with this corps an interesting ceremony took place on Friday last, the 16th inst., at the Northampton Institute, when Mr. Kenelm Edgcumbe, who holds a commission in the detachment which is proceeding to South Africa, received the good wishes of his numerous friends in the Institute. Mr. Edgcumbe has for two sessions been Senior Demonstrator in the Electrical Engineering Department, and in this position has been a popular member of the staff. His colleagues and the students, therefore, combined to present him with a Goerz binocular field glass of the prism type, and a prismatic compass of the latest patent. The presentation was made by Dr. Walmsley, the Principal of the Institute, at a well attended meeting in the large hall last Friday, amidst the enthusiastic demonstration of members and students of the Institute.

Electric Shock Fatality.—As we go to press we regret to learn that one of the assistants at the Blackheath Electric Light Company's station was killed on Wednesday morning by a 3,000-volt shock.

Scarcity of Carbons.—Electrical manufacturers and the trade generally, have to take into account scarcity and consequent high prices of certain materials at the present moment, and it is therefore timely to point out that there is likely to be considerable difficulty in obtaining delivery of electric light carbons. The bulk of these carbons up to the present are made on the Continent (where there is at the moment a serious coal strike), and houses who trade in carbons must be prepared to experience some little difficulty as regards delivery. It may become necessary, therefore, to exercise some forbearance and make allowances for late deliveries, and blame the situation rather than the suppliers. We understand that a representative of a prominent English electrical manufacturing and trading firm has recently been in several towns on the Continent where carbons are made, and he reports that the whole of the carbon works are at a standstill; telegrams are pouring in from everywhere, and yet the works cannot turn out anything. A few days ago the Bohemian strikers intended starting work again, but another strike broke out in Saxony, and the Bohemians were therefore influenced not to start. He also reports that there does not appear to be

any hope of getting any carbons manufactured for at least three or four weeks, which will mean that further supplies cannot reach here until probably towards the end of April or May. It may happen, perhaps, that serious consequences will result where contracts have been made for "town lighting," and where carbons have not been laid in store, as they will absolutely be left without them during the next few months. While not wishing to create anything of a scare in regard to the matter, we think this warning may serve a useful purpose.

Penalty Clauses.—The Police Commissioners of Stirling held a special meeting on Tuesday to consider what should be done in connection with a proposal to enforce the penalty clauses in certain contracts for electric lighting plant, the delivery of which was considerably behind the time specified, one of the suggestions being that part of the contract price should be withheld. The proceedings were held in private, but we understand that a letter was read from Prof. Kennedy, the engineer of the scheme, advising payment of the contract prices, and not to insist on the full penalties. This course was adopted, and the likelihood is that the Commissioners will arrange the matter amicably with the contractors.

Lectures.—At the Hull Royal Institution on Tuesday, Prof. O. Lodge lectured to the Hull Literary and Philosophical Society, upon "Electrical Vibration."

Before the Bradford Textile Society on 19th inst., Mr. Malcolm E. Hodgson gave a lecture to the members upon "Electricity for Driving Looms." He drew attention especially to the growing use of electricity as a motive power for looms, and advocated the use of ½-H.P. motors directly geared to the driving shaft in the case of looms for the manufacture of heavy cloths, and connected by belting in the case of looms for the manufacture of light cloths. He remarked that this method of driving was becoming of great importance on the Continent, where the conditions favoured it more than the conditions which prevailed in Bradford. In many cases mountain torrents were utilised to supply the generating power, and the hand loom and treadle loom were being superseded by looms electrically-driven.

Before the Staffordshire Iron and Steel Institute at Dudley last Saturday night, Mr. G. L. Addenbrooke read a paper on "Electrical Transmission and its Industrial and Economical Aspects."

Prof. Emerson Reynolds delivered the third of a series of afternoon lectures in the theatre of the Royal Dublin Society last week, on "Electrical Furnaces and High-Temperature Changes."

The Decimal System.—It must be somewhat disheartening to the advocates of the decimal system in this effete old monarchy of ours to see the use made of it in the Transvaal. No doubt the thin end of the wedge was inserted by the purchase of Creusot guns of so many centimetres diameter, but the Pretoria Government has adopted a beautifully simple method of figuring up losses. British casualties are multiplied by 10, Boer ditto divided by 100. It is said, however, that the Free Staters, or those that were left of them in the front ranks after the determined assault on Ladysmith, do not appreciate Kruger's methods of reckoning.

The Electro-Harmonic Society.—The last "ladies' night" of the season takes place this evening at the Café Monico. Lovers of vocal music will be pleased with Madame Perrott, and Mr. Samuel Masters is rapidly getting into the very front rank of tenors. Mr. Parker will, as on several previous occasions, perform on the violoncello, and Mr. Minshall, Mr. and Mrs. John Warren, and Mr. Chas. Conyers will respectively give recitations, thought transmission séances, and humorous sketches. Last, but not least, Mr. Izard will play a pianoforte solo, and act as accompanist throughout.

South African Cables.—The third telegraph cable to the Cape was completed and opened for traffic yesterday. It is laid *viâ* Ascension and St. Helena.

Appointment Vacant.—A mains superintendent is wanted for the West Ham electricity department at £156 per annum. See "Official Notices" to-day.

Awards.—The Manchester Literary and Philosophical Society held a special meeting at Manchester, on 13th inst., to award the Wilde medal for 1900 to Lord Rayleigh for his numerous and brilliant contributions to mathematical and experimental physics, and to chemistry. The Dalton medal was presented to Sir Henry Roscoe for his remarkable original researches in chemistry, and for his distinguished services to scientific education. Lord Rayleigh afterwards delivered the Wilde lecture, taking as his subject, "Flight, natural and artificial."

Presentation.—Mr. A. J. Lawson has been presented with a handsome silver inkstand by the engineering staff of the County of London and Brush Provincial Electric Lighting Company, Limited, with suitable inscription.

NEW COMPANIES REGISTERED.

Electrical Regulating and Lighting Syndicate, Limited, (65,001.)—This company was registered on February 9th, with a capital of £75,000 in £1 shares, to acquire Patents No. 21,236 of September 25th, 1896, and No. 4,761 of February 20th, 1898, to adopt an agreement with Walter Emmott (the patentee), Frederick Whiteley, Thomas R. Bottomley, and Jeshurum Longthorpe, and to carry on the business of electrical and mechanical engineers, brass founders and finishers, tinsmiths, iron founders and turners, blacksmiths, brass, iron, steel, metal, and India-rubber merchants and general factors. The first subscribers (each with one share) are:—J. Longthorpe, Oak Leigh, Buttershaw, Bradford, Yorks., dyer; John Wilson, Dock Villa, Wibsey, Bradford, Yorks., printer; J. E. Crossley, Sovereign Street, Leeds, Yorks., drysalter; John Hillary, Rushford Park, Levenshulme, Lancashire, consulting engineer; Alfred Deakin, 100, Great Tower Street, E.C., printer; William L. Smith, 116, Stanstead Road, Forest Hill, solicitor's clerk; and Harold H. Barnes, "Ferndale," Aldenham Road, Watford, correspondence clerk. The number of directors is not to be less than four nor more than seven. The first are Thomas R. Bottomley, Walter Emmott, Jeshurum Longthorpe, John Hillary, and Frederick Whiteley; qualification, £250; remuneration as fixed by the company.

CITY NOTES.

Westminster Electric Supply Corporation.

The annual meeting of this company was held on Wednesday at Eccleston Place station, S.W., Lord Suffield presiding.

In moving the adoption of the report, his Lordship congratulated them on the steady and satisfactory progress the corporation was still making. At the meeting last year he stated that the board had no reason to expect a falling off in the demand for supply, and as they would see from the report, not only has there been no decrease, but the number of lamps added last year had been greater than in any year since they commenced business. Although the cost of steam coal had been, and was still, owing to the great demand, very high, the profit for the past year shows a large increase, and the directors had, therefore, felt justified in recommending an increase in the dividend of 1 per cent. They had also added largely to the sinking fund and depreciation account, and had been able to carry forward a sum of £3,773 8s. 2d. The works' costs, as well as the management expenses, compared very favourably with the previous years owing to the increased output. They would notice that in his certificate Mr. Pearson, the Government auditor, had taken exception to an item of £1,582 5s. 9d., which they had taken credit for in the net revenue account. This was for interest on the advances the corporation had made to the Central Electric Supply Company, Limited, and the auditor was of opinion that as that company was owned by the St. James's Company and the Westminster Company, and is not at present earning any income, it would have been better not to take into account the amount of interest accrued. The directors were, however, of opinion that if they had not taken into account the interest accrued to December 31st last, which was to be paid thereafter, the accounts would not have shown the correct position of the company at the end of the year 1899. This amount had not been expended in dividend, but was included in balance carried forward. They would, no doubt, have observed that they had come to the end of their capital, and the directors had now under consideration the question of the provision of future capital. When they had decided as to the best means of providing for future requirements, due notice would be given to the shareholders of the proposals of the directors. He then formally proposed that the report and accounts for the past year be received and adopted.

Mr. Boulnois, M.P., seconded.

A Shareholder asked if the corporation had any contract for future supply of coal, and in reply the chairman said that they had a contract running until the end of May at last year's prices.

Another Shareholder, a member of the Coal Smoke Abatement Society, referred to the experiments which had been carried out for smoke abatement, and he asked if anything had been done to stop

the nuisance which was always occurring from the Millbank chimney. The company's other chimneys were not such great offenders, but the one on the embankment was reported nearly every day. He asked regarding the change over to 200 volts, whether there had been any greater complaint of the supply from consumers since the 200-volt pressure had been brought in. His own experience, and that of his friends, was that the lamps did not last as long, or give as good a light for as long a time, as the old 100-volt circuit. Every lampmaker said that the lamps gave very much the same result. Electrical engineers told him that there was not in the market a good 200-volt lamp, and his own experience led him to agree with this. If it was so, there would be considerable dissatisfaction in the long run.

Mr. GRIMSHAW was asked to reply regarding the smoke trouble at Millbank Street. He said that they had been making a great number of experiments, and had spent money in trying to stop the smoke. They were only troubled with it just as they were getting up the fires at night. It was not nearly so bad at their Millbank works as at other company's works. They took the best coal they could buy, and were always on the look out for patents which would stop the smoke, and were ready to put them in experimentally.

Captain EDMUND BAX replied regarding the 200-volt question. He said that they had had a great number of people complaining of the 200-volt supply as against the 100-volt, but he thought that it was only because they had made a change from 100 to 200. In other companies where they had started by giving supply at 200 volts, they did not hear those complaints, but the moment they changed over from one to another it did not matter what the voltage might be the consumer would complain because they began to alter his wires and to do this, that, and the other. As to the efficiency of the 200-volt lamp, it was not quite so efficient as the 100-volt lamp. There was not any very great difference, but in a very large block of buildings, with a great many thousands of lights, experiments had been made, extending over a year with 100 volts, and a year with 200 volts, and they had found that the amount of the consumers' bill when supplied at 200 volts was not appreciably greater than when supplied at 100 volts. There was no reason, therefore, for complaining, but in order to meet consumers' complaints, they made an allowance of 8 per cent., so that they might take 200 volts instead of 100 volts. By doing that they claimed to more than meet the inefficiency of the 200-volt lamp.

The report was then unanimously adopted, the retiring directors were re-elected, and the meeting closed with the usual vote of thanks.

The British Insulated Wire Company, Limited.

THE fourth ordinary general meeting of this company was held on Friday last, the 16th inst., at Prescot, Mr. W. Marriner Brigg presiding.

The CHAIRMAN, in proposing the adoption of the report, congratulated the shareholders on the continued growth and success of the business. He thought perhaps the shareholders hardly realised what this continued growth and increase meant. Since the company started in 1892, the increase had been on the average 50 per cent. on the year previous. Now they could quite imagine that when that got up to, say, £1,000,000, and they suddenly found they reached £1,500,000, it made a very considerable difference in the calculations, and in the working of the business, and that had been the case up to the present, and he thought it was a very remarkable fact in connection with any industry. To go on continuously as this business had done, showed that the business in itself was good, and the stuff sent out was good, and that the demand was gradually increasing, and perhaps he might just say here that he thought the orders which they had in hand justified them in thinking that their increase for the present year was going to be after the same rate. Turning to the balance-sheet, they would notice in the first instance that the profits were about £20,000 more than last year. The report showed that the profit was £92,000 against £72,000 last year. The administration expenses, legal expenses, fees, &c., were necessarily higher, because they were doing a much larger business, but the directors did not think those expenses were abnormally extended, or were beyond the ratio in which they should be extended according to the business which had been done. They could not tell till the end of the year what the increased capital had done for them, but they had every reason to believe that the money which they now asked for could be very profitably spent. If he said that the orders they now had on the books were equal to the whole of the turnover for a year or a little more than a year or two ago, they could imagine how they stood in the month of February with orders on their hands for more than they turned over a year or two ago. He hoped that 15 per cent. and the bonus of 5 per cent. would be agreeable to the shareholders, and that they would sanction what they had done.

Mr. E. K. MUSPRATT seconded the resolution. He endeavoured to explain how it had arisen that they really required this rather large acquisition of capital. Last year, or rather, the last two years, the price of nearly every article had increased. That was owing to the prosperity of the country and to the enormous increase of the industry. The price of copper, for instance, had gone up from £50 a ton to a very high figure—at one time it was £90 a ton and now it is somewhere about £76 or £77 a ton—so there was an enormous increase in the price of the material of which they used an enormous quantity. The consequence was that together with the increased business had entailed a larger quantity of copper being used in the business, and had caused them to require more capital to carry on the business. The same thing applied to lead. The quantity of lead used for covering cables had enormously increased on account of the increased business, and the price of lead has gone up from somewhere about £11 a ton to somewhere about £16 or £17 a ton. They did a remarkably safe business as far as bad debts were concerned, because the greater portion of their business was done with Corporations, and they had the rates to fall back upon as security. But although Corporations were very good payers they did not always pay cash down, and they insisted very properly that a certain amount should be held in hand to meet any contingencies of bad work or anything that may arise. The consequence was that in these large transactions with Corporations it was necessary for a large amount of the money to lie out for a considerable time. This was another reason why they required this increased capital, and the only question really was in an enormously growing business like this, whether they were going to ask for enough, and whether it would not be necessary in two or three years to ask for a further increase, because they were all aware that the electrical industry, in this country at any rate, was of comparatively recent growth. Now, however, it had taken a firm hold of the country, and there was no question but that it would increase to a far larger extent in the future. Wherever they had to apply electrical power in order to transmit that power cables were required, and with every increase of electrical installations in the country cables are required for transmission. He therefore anticipated a very large increase in their business.

The resolution was carried unanimously.

At an extraordinary meeting, which followed the resolution increasing the capital to £1,000,000 by the creation of 120,000 new shares of £5 each was carried.

The directors of the British Insulated Wire Company, Limited, have issued (pursuant to resolution of the shareholders on the 16th inst.) 30,000 6 per cent. cumulative preference shares and 30,000 ordinary shares both of £5 each. The former have been issued at £5 10*s.* and the latter at £10, which in each case is less than the market price of the hitherto existing shares. The issue has been to shareholders only, who thus receive the benefit of the difference between the market price and the issued price. The issue, with the premiums, provides additional working capital of £465,000, which the directors are satisfied can be profitably employed.

Liverpool Overhead Railway Company.

THE half-yearly general meeting of the Liverpool Overhead Railway Company was held on Tuesday at the Law Association Rooms, Cook Street, Liverpool, Mr. Richard Hobson, deputy chairman, presiding.

The CHAIRMAN, in moving the adoption of the report, said the directors had much satisfaction in presenting it, and he thought the shareholders would receive it with similar feelings. It was a record one in regard to the number of passengers carried and the amount of money earned, as well as in the dividend which they asked the shareholders to declare. He wished he could say that the dividend had been earned upon normal lines, but he had to admit that exceptional circumstances had assisted them during the last few months. The enthusiasm which had arisen throughout the country upon the departure of the volunteers and the military for South Africa had extended to Liverpool, and the transports sailing from the Mersey had brought great crowds to witness each departure, with the result that the Overhead Railway had benefited to the extent of between £1,500 and £2,000 from that cause. Perhaps some of the shareholders might think, under such circumstances, that it would not be advisable to pay away in dividends all the money thus earned; but he could assure them that the directors had more adequate provision for all contingencies, and they did not see why the shareholders should not benefit by the piece of good fortune they had had. Furthermore, the benefit they had derived from that source did not cease at the end of December, because during the six weeks since January 1st the traffic receipts had increased £1,140 as compared with the corresponding period of last year. Referring to the accounts, he said the cost of maintenance and renewal of permanent way was much less than last year. That, on the face of it, might seem as if they had not kept up the line properly, but that was not so, because last year they had incurred considerable expense in laying additional rails and replacing, which they had not had to do in the past half-year. Therefore they were enabled to put to the renewal fund £2,000, as against £1,500 at the corresponding period of the previous year. Those present at last meeting would probably remember that in the first six months of the year they took from the reserve £1,000 in payment of signalling and lighting expenses that were incurred; and the directors thought, as they had a good half-year now, they ought to put a little more to the renewal fund, and that was the reason they put £2,000 instead of £1,500. The coal account was £300 more than in the previous half-year; but he was glad to say that in the matter of iron, which was also much enhanced in price, they were fortunate in purchasing a considerable quantity of rails at the very lowest point of the market, and they had still a large quantity on hand, so that they were not likely to feel the pinch in that direction. The cost of the repair and renewal of the carriages was considerably less than in the previous six months.

Mr. JOHN BRANCKER seconded the motion, which was carried.

The CHAIRMAN next proposed that a dividend of 5 per cent. per annum be paid on the preference shares for the past half-year, and a dividend of 5 per cent. per annum be paid on the ordinary shares for the same period, leaving a balance of £4,591 to be carried forward to the current account.

Mr. G. H. ROBERTSON seconded, and the motion was carried.

Messrs. Richard Hobson and James Barrow were re-elected directors, and this concluded the business of the ordinary meeting.

Afterwards a special meeting was held, and the CHAIRMAN moved that £50,000, being the whole of the share capital authorised to be created by the Liverpool Overhead Railway Act, 1899, be created in 5,000 ordinary shares of £10 each, and that the directors be authorised to issue the same as they may think fit. He explained that the resolution was a consequence of the authorisation given by the shareholders to the arrangement made for an electric railway through the Waterloo, Seaforth, and Great Crosby districts. He did not think they would want more than £30,000 to £35,000—the whole cost appertaining to the tramway company was under that amount, but they proposed to put down a 1,500 H.P. engine for the generating station, which would be of much assistance in working the line generally, and it was included in the £35,000. They would probably wait for a more favourable condition of the money market before issuing the shares.

Mr. JOHN BRANCKER seconded.

The CHAIRMAN, replying to a question, said if there was any benefit to be got by the present shareholders from the issue of these shares, it was right they should get it.

The motion was carried.

A further special meeting was held, at which the CHAIRMAN moved that the Bill proposed to be introduced into Parliament, authorising extensions of the line, be approved. He explained that the most important proposals were the extension of the present terminus at Seaforth to the Lancashire and Yorkshire Company's station at Seaforth, and to widen the line at the Pierhead Station so as to enable them to run trains from the north and south to that point without running them through. A third proposal was to extend the line at the Herculaneum Dock, and form a connection with the L. and Y. Railway at the South End for the purpose of goods traffic; but as that was objected to by the Dock Board, it would be taken out of the Bill, as they had no intention of proceeding with an opposed measure. He believed the other portions would be got through without opposition.

Mr. JOHN BRANCKER seconded.

Mr. ALFRED HOTT spoke against any further extension of the line, arguing that if they had been content with their "shuttle" line from the beginning, they might have run twice as many trains and been paying a dividend of at least 10 per cent. The backbone of the company was the traffic along the line of docks; that was what the line was made for, and it would be impossible with these extensions to run the trains punctually.

The CHAIRMAN, in reply, said the extensions north and south were yielding a fair revenue, and they must have feeders to their line.

The motion was carried, after which the meeting terminated.

Dublin United Tramways Company.

THE following is the directors' report submitted at the meeting of the company in the Imperial Hotel, Dublin, on Tuesday, last week:—

"The directors herewith submit the accounts for the half-year ended December 31st, 1899, together with details of the working of the Dublin United (Old) Company and the Dublin Southern District Company. The following is a summary of the various net revenue accounts:—

"*Dublin United Tramways (Old) Company.*—Net profit for half-year, £37,648 5s. 4d.; balance brought forward from June 30th, 1899, £78 3s. 11d.—£37,726 9s. 3d.; less interest on mortgage bonds, interest paid to bank, and wayleave rents, £7,841 3s. 9d; total at credit of net revenue, £29,885 5s. 6d.; less dividends declared (£18,000) and interest on cash lent by D.U.T. (1896) Company (£8,000)—£26,000; balance carried to next account, £3,885 5s. 6d.

"*Dublin Southern District Tramways Company.*—Net profits for half-year, £12,306 12s. 3d.; balance brought forward from June 30th, 1899, £6 7s. 7d.—£12,312 19s. 10d.; less wayleave rents, £711 15s. 10d.; dividends declared, £11,590—£12,301 15s. 10d.; balance carried to next account, £11 4s.

"*Dublin United Tramways Company* (1896) *Limited.*—Balance brought forward from June 30th, 1899, £484 10s. 11d.; interest received on loans to old company, £8,000; dividends on shares held in Dublin United (Old) Company, £17,936 2s.; ditto in Dublin Southern Company, £11,590—£38,070 12s. 11d.; less interest on 3½ per cent. debentures, £3,451 3s. 7d.; less balance of directors' fees, £450—£3,901 3s. 7d.; balance available for dividends, £34,169 9s. 4d. Your directors have declared a dividend at the rate of 6 per cent. per annum on the preference shares, and at the rate of 6 per cent. per annum (free of income-tax) on the ordinary shares, numbered 1 to 51,450. This dividend will absorb £32,831 4s. 7d, leaving a balance of £1,338 4s. 9d. to be carried to next account.

"The aggregate balances of undivided profits of the three companies carried forward to next account amount to £5,238 14s. 3d. A deficiency of £13,366 was incurred in connection with the disposal of the horses of the Dublin United Tramways Company. £6,487 of this deficiency has been charged against a reserved fund of about equal amount belonging to the same company, and the balance (£6,879) is carried to a suspense account to be written off out of future revenue. During the half-year the reconstruction of all the existing tramways necessitated by the electrical equipment, except a portion of the Sandymount, Donnybrook, and Blackrock lines was completed. Of the works authorised by the Privy Council Order of 1898, the extension and doubling of the Glasnevin line, the doubling of the Drumcondra line, and the construction of the new line through Leeson Street, have been completed. The British Street and Summerhill new line, and the new line *viâ* Brunswick Street and Ringsend, to join Sandymount line at Irishtown, authorised by the same order, are in course of construction. The new central power station at Ringsend Road commenced working on August 16th last. The result of its operation has completely justified the expenditure incurred in the construction and equipment of what is at this date the finest and most effective generating station in Europe. Two of your directors—William M. Murphy and William Anderson—retire, and being eligible, offer themselves for re-election. One of your auditors—Robert Gardner—retires by rotation, and is eligible for re-election. The dividend warrants will be sent out on the 24th inst."

The half-yearly general meeting of this company was presided over by Mr. Wm. Murphy, J.P.

The CHAIRMAN, in moving the adoption of the report, said that during the half-year they had practically brought to a completion the conversion of their system from horse to electric traction. The result was that they now had a system of electric traction which was acknowledged to be beyond any other in the United Kingdom to-day, both in extent and in the perfection of its detail. They were frequently visited by deputations from large English and Scotch cities, who expressed a determination to follow the types in which, as far as these countries were concerned, they were the pioneers. The generating station at Ringsend (opened in August) was working for some months under unfavourable conditions for the most economical production of electrical energy. The overlapping of expenses and disorganisation incident to the changes in the operating system could not be wholly avoided. Moreover, between the war and the prevailing epidemic, many of their skilled men were not available, so that they could not at all times provide sufficient service to carry the public. But still the profits enabled them to increase their dividend by 1 per cent. The company's account showed an increase of £5 561 in gross receipts, but the net profits were £10,691 more than in the corresponding period, from which it was apparent not only that they increased their traffic receipts by more than £5,000, but that it cost them £5,000 less to earn the increased receipts, and that was the secret of the success of the electric system—namely, increased receipts and diminished expenses; £1,841 of the increased profits were absorbed by wayleaves which only accrued in the last half-year. The cars on the company's system during the half-year travelled 2,180,832 miles, of which 730,245 miles, or more than one-third of the whole, were still covered by horse haulage. There was a proved difference of 4d. per mile in favour of electric haulage. The increase in the net profits of the Southern District Company's system was £2,644, the profits being in 1898 £8,951, and in 1899 £11,594, after deducting wayleaves of almost equal sums in both cases. The debenture interest chargeable against this company being also the same in the two half-quarters, the whole of this increased net revenue was available for dividend. The proportion of working expenses to gross receipts on the Southern system was 48·5, and by charging each system with its own proper expenditure, and by a rateable division of expenses for horse and electric working, the United Tramway Company's system did not exceed 50 per cent. of the gross receipts. They had now 180 cars in operation, and he looked forward to finding profitable business in the month of August next for at least 250, and they were providing that number. They also looked forward to a large saving in the cost of production of electric energy in the Ringsend power station. The economy of working from Ringsend had led to the closing of the Clontarf station, and when the proposed multiphase machinery was completed the Ballsbridge station would be closed down and the entire system would be worked from the central power station, thus saving £25,000 per annum. The past half-year was not a favourable one, owing to the high price of money, for selling the balance of debentures, and they did not press the sale. The chairman then referred to a difference the company had with the British Thomson-Houston Company regarding the costs of the lowering of the Kingstown sheds, which they were advised were due to them by the company under their indemnity. That opinion was disputed, and the matter would be disposed of by a friendly suit. The company had given the public a speedy and luxurious means of travelling at little more than half the former fares.

Mr. J. R. WIGHAM seconded the motion, which was adopted after a brief discussion, in which some few reductions in fares and extensions of the system were suggested.

The CHAIRMAN, replying to a shareholder, said £90,000 debentures were still unissued, and they would have to raise additional capital.

Scarborough Electric Supply Company, Limited.

THE directors, in their report, state that during the past year 82 additional consumers, and the equivalent of 4,827 8-C.P. lamps, have been added to the company's system, making a total of 465 consumers and 27,171 lamps connected at the present time. During the past year electric energy to the amount of 257,412 Board of Trade units have been supplied to customers, at a revenue, including meter rents, of £6,235 12s. 11½d., as against 220,009 units and £5,442 9s. 8½d. revenue in 1898. Although the increase in the price of coal has proved a serious item, the profits on the year's working is £2,705 8s. 9½d., as against £2,331 16s. for 1898. Adding to this the balance of £368 6s. 11½d. carried forward from 1898, and the sum of £80, being premiums on new shares issued, there is, after paying income-tax, £71 2s. 5d., bank interest, £34 15s., and putting £471 17s. 5d. to depreciation, a sum of £2,576 0s. 11d. available for distribution. The directors recommend that this should be applied in paying a dividend of 6 per cent., free of income-tax, which will absorb £2,416 13s. 3d., leaving a balance of £159 7s. 8d. to be carried forward. As will be observed, the depreciation fund now stands at £1,400, as against £900 last year. The whole of the company's capital being now issued, and further expenditure being required to keep pace with the growth of business, the directors have deter-

mined to advise the shareholders to increase the capital to £100,000 by the creation of 5,000 additional shares of £10 each, to be issued and called up from time to time as required, as the directors may determine. The directors also think it well to state that they have recently been approached by the Corporation of Scarborough with a view to the purchase by the latter of the company's undertaking. No definite proposals have as yet been formulated, but in the event of any definite offer being made, the matter will, of course, be laid before the shareholders. In the meantime the Corporation have introduced a Bill in Parliament, which in one or more of its clauses affects the company. The directors have taken the needful steps to watch the interests of the company in Parliament. The chairman (Mr. George Alderson-Smith), Mr. G. L. Beeforth, and the Hon. C. A. Parsons retire by rotation, but are eligible and offer themselves for re-election as directors. The auditors, Messrs. Bradley, Davis and Co., chartered accountants, also offer themselves for re-election.

The annual meeting was held at Scarborough on 19th inst., Mr. G. Anderson Smith presiding. The report was adopted. The retiring directors, Messrs. Alderson Smith, G. L. Beeforth, and the Hon. C. A. Parsons, were re-elected. At an extraordinary meeting which followed, the directors were authorised to increase the capital of the company by the creation of 5,000 shares of £10 each.

Portrush and Giant's Causeway Electric Tramway Company.

The twenty-fourth ordinary meeting of the shareholders of the above company was held at its offices, Portrush, recently, Dr. Anthony Traill, J.P., presiding. The following is the report of the directors as submitted to the meeting:—

Your directors have to report a considerable increase in the receipts as compared with the previous year, viz., from £2,405 8s. 9d. to £3,010 17s. 10d. This has arisen almost entirely from the increase in the number of passengers carried during the year from 74,877 to 94,151. The credit balance on the year's working was £914 16s. 3d., as against £502 5s. 5d. in 1898. The number of miles run by electricity during the year have been 17,875, as against 11,338 in 1899; and the miles run by steam have been reduced from 18,979 to 11,771, making the total number of miles run last year 29,646, as against 25,312 in 1898. In last year's report your directors expressed the hope that the new overhead system would be in working order in good time for the height of the season. The hope was fully realised, and the large increase in the receipts is principally due to this fact, combined with the existence of fine weather during most of the summer. Had this fine weather not been brought to a sudden conclusion by a complete break-up in the middle of September the balance to credit of the net revenue account would have been even larger than it has been, though it has increased during the year from £502 5s. 5d. to £914 16s. 3d. It will be seen from the revenue account that considerable outlay has taken place during the year on the maintenance of way and works, and also on the repairs of cars, so that the line and rolling stock have been kept up to a high state of efficiency. This is only a continuance of the principle always acted on by your directors with a view to the comfort and security of the passengers. It will also be observed that the item of "law charges" has disappeared from last year's account. Your directors regret to say, however, that they are involved this year in a lawsuit, instituted by the Urban Council of Portrush to compel your company to discontinue running cars by electricity through the streets of Portrush, and to remove the poles which maintain the overhead wire. That a public body could be found at the end of the 19th century to take up such a position against a company which has been the pioneer of all electric railways, now so widely scattered over the world, is an amazing fact, and a poor tribute to the success of the new Local Government Act; but, as the poles in question were erected under the powers of an Act of Parliament, and were *in situ* before the Urban Council came into existence, your directors leave the result with confidence in the hands of the courts of law. The increase of expenditure under the head of "Electricity" from £149 18s. 11d. to £373 2s. has arisen from the necessity of completely overhauling and renovating the turbines at the waterfall on the River Bush, so as to render them fully efficient to generate the electric current at the much higher potential allowed for the overhead system of transmission than was possible with the old electric rail, which was only 18 inches above the ground. An examination of the net revenue account will show that the balance to credit as the result of the year's working has been sufficient to pay the interest in full on all debenture stock, amounting at present to £12,950, and also on the mortgage for £10,000, which was raised when the line was completed from Bushmills to the Giant's Causeway. Your directors have every hope that when the new system shall have had a fuller trial they will be able to recommend a dividend on other portions of the capital of the company.

The report was adopted on the motion of the Chairman, seconded by Mr. James Stewart Moore. The engineer's report was also submitted by Mr. Wm. A. Traill, C.E., and considered satisfactory. Messrs. C. M. D. Stuart, J.P., and W. A. Traill, who retired from the board of directors by rotation, were re-elected.

W. T. Henley's Telegraph Works Company.

The directors, in their report for the year 1899, say that of the £120,000 additional preference capital authorised by the shareholders in 1899, £90,000 was taken up by the shareholders or their nominees at par, and £30,000 by the holders of the old 7 per cent. preference shares, with the sum of £30,000 paid to them out of reserve account as compensation for the reduction of the dividend on those shares to 4½ per cent., in accordance with the resolutions passed at the general meetings held in 1899. The accounts show that during the past year a net profit has been made of £46,037. After payment of debenture interest and income-tax, and making ample allowance for depreciation of buildings, plant, machinery, &c., there remains £40,311, making, with £14,528 brought forward from last year, a total of £54,840 available for distribution. The directors have transferred £10,000 to the reserve account, and they recommend the payment of the following dividends, viz.: On the preference shares at the rate of 4½ per cent. per annum (less income-tax) on the ordinary shares at the rate of 15 per cent. per annum (less income-tax), including the interim dividend of 4 per cent. paid on September 1st last. These payments will together amount to £35,986, leaving £18,853 to be carried forward. The dividend warrants will be posted on February 28th, 1900.

The Notting Hill Electric Lighting Company, Limited.

The tenth annual report of the directors to be presented to the meeting at Notting Hill on Tuesday, March 6th, reads as follows:—

"The directors herewith submit to the shareholders the accounts of the company to December 31st, 1899. The expenditure on capital account at the date of the last balance-sheet stood at £128,003 19s. 4d., and during the past year a further sum of £9,346 14s. 3d. has been expended, of which £7,850 10s. 6d. was on new mains and meters, and £1,000 in the acquisition of the buildings erected on the freehold land belonging to the company in Victoria Gardens. This brings the total expenditure to £137,350 13s. 7d., which is £6,350 13s. 7d. in excess of the capital received. The only additional sum received on capital account was the £5,000, balance of instalments due on debentures issued in 1898. The following table shows the progress of the company:—

					£ s. d.
1891	Lamps	6,056	.. Loss	..	554 14 6
1892	"	9,438	.. Profit	..	112 6 1
1893	"	13,153	.. "	..	1,481 7 1
1894	"	15,669	.. "	..	2,101 17 8
1895	"	20,307	.. "	..	3 227 14 10
1896	"	25,716	.. "	..	4,736 9 8
1897	"	33,000	.. "	..	6,854 1 2
1898	"	46,066	.. "	..	7,251 13 7
1899	"	59,154	.. "	..	10,360 17 4

The number of consumers is now 1,012, and of these all but 15 per cent. are supplied at 200 volts. The cost of coal shows an increase of £430, or 30 per cent. over the amount of last year, whilst the amount realised by the sale of current shows an increase of 35 per cent. The pressure of the current at the same time has been kept up to its proper standard, and uniformly steady throughout the year. In accordance with the powers given to the directors on March 1st, 1899, application was made to Parliament for an Act, authorising the company, in conjunction with the Kensington and Knightsbridge Electric Lighting Company, to purchase land and erect a joint station for the purpose of economically generating electricity in bulk. This Act received the Royal Assent on July 13th, and a committee consisting of Messrs. A. E. Franklin and J. T. Jervis representing this company, and Sir Frederick Bramwell and Mr. Granville R Ryder representing the Kensington and Knightsbridge Company, in conjunction with the engineers and secretaries of the two companies, have been engaged during the year in making arrangements for the erection of the necessary buildings, and their equipment with the most modern description of machinery. It is estimated that the expenditure on these joint works will amount to between £80,000 and £100,000, and it is proposed to raise the necessary capital by a loan to be redeemed by a sinking fund in the year 1931, when the property of this company is liable to be purchased by the local authority. The two companies have entered into a mutual agreement to take current from the station in accordance with their several requirements, and to contribute each year, in proportion to the current taken, such amount as may be required for the working expenses and upkeep, together with the interest and sinking fund of the borrowed capital. In the year 1931 the property will revert, free of incumbrances, to the two companies in proportion to the respective amounts contributed. The directors anticipate that the result will be not only a greatly increased power in the production of electricity, but also that the shareholders will possess a reversion of considerable value, to accrue at the time when their present property is liable to expropriation, thereby constituting a large reserve fund, securing them against possible loss in case of under-valuation. In conjunction with the new works the directors propose to make considerable extensions in districts in the company's area not hitherto supplied, where they have every reason to believe that remunerative business will be obtained. Should it be possible, as anticipated, to make these extensions during the current year, additional capital will be required, and as the present powers of the directors in this direction are limited to the issue of £19,000 of debentures at present unissued, it will be advisable to provide for an increase of capital. Should this contingency arise, a special meeting will be called in due course, when the details of the proposals will be brought forward for consideration and approval. Of the £10,360 17s. 4d. profit, the directors have set aside £1,500 for depreciation and reserve fund, bringing the total amount up to £6,000. This they consider sufficient, partly in consequence of the arrangements detailed above, but especially in view of the fact that the whole of the capital expenditure of the company, with the exception of the £3,833 19s., representing the cost of provisional order and the purchase of patents, &c., is entirely represented by visible assets at prime cost. All repairs and renewals have been paid for out of revenue. After paying the debenture interest, amounting to £1,183 6s. 11d., and 6 per cent. on the preference shares, amounting to £1,798 16s., there is a balance of £5,827 18s. 7d., out of which the directors recommend a dividend of 6 per cent. on the ordinary shares, amounting to £3,871 4s., leaving a balance of £1,956 14s. 7d. According to the articles of association, one-half is credited to the holders of the founders' shares, and out of the other half, including the amount brought forward from last year, it is proposed to pay a further dividend of 1 per cent. on both the preference and ordinary shares, making 7 per cent. for the year, and leaving a balance of £64 14s. 9d. to be carried forward. An interim dividend of 3 per cent. was paid on July 1st, and the balance of 4 per cent. will be paid forthwith, together with a distribution of £1 16s. per share to the founders' shares. The directors desire to place on record their appreciation of the services of the engineer and manager, secretary, and staff generally. It is with deep regret that the directors have to announce the death, in his 80th year, of their esteemed colleague, Mr. Francis Radford, whose business capacity and important local influence greatly contributed to the success of the company. The directors retiring in

rotation are Messrs. A. E. Franklin and J. T. Jervis, who, being eligible, offer themselves for re-election. The shareholders' auditors, Messrs. Fox, Sissons & Co., retire, and being eligible, offer themselves for re-election. The accounts will be audited in due course on behalf of the Board of Trade."

The Edison and Swan United Electric Light Company, Limited.

An extraordinary general meeting of this company has been called for Tuesday, February 27th, at Westminster Palace Hotel, at 12 o'clock noon, for the purpose of considering, and if deemed desirable, of passing, a resolution authorising the directors to create and issue debenture stock providing for the payment of principal sums not exceeding £300,000, and carrying interest at a rate not exceeding 5 per cent. per annum, such debenture stock to be secured in such manner (subject to the existing debenture stock already issued by the company to the amount of £350,000), and to be issued to such persons and on such terms as the directors shall think fit. The circular reads as follows:—

The board have found it necessary to call a special meeting of the company as set forth in the accompanying notice, to advise with the proprietors as to the provision of further funds to carry on the rapidly increasing business in lamps, fittings, and the numerous accessories involved in electric lighting. The board will recommend the creation of a sufficient amount of second debenture stock, not exceeding in the whole £300,000, to be issued from time to time as circumstances may require over a period of several years. The profit-making power of the company is increasing from year to year in a very satisfactory manner, and bids fair to expand even more rapidly as further capital is provided. The necessities of trading on a much larger scale than formerly—more workshops and plant—considerable variety and quantity of articles required in the business—as well as the necessity of giving reasonable credit to the numerous traders and installers who are customers of the company—all entail a temporary lock-up, so to speak, of a considerable sum, to that the existing capital does not afford a sufficiently broad base to work upon. The directors have just had before them the accounts for the half-year ending December 31st last, which show the steady advance which the company is now making, notwithstanding severe competition, and the absence of any special patent privilege. The chairman proposes at the meeting to explain to the shareholders the present position of the company, and to show the sound basis on which the company stands, and the directors' estimate of the full value of the assets of of the company as stated in the company's balance-sheet.

Newcastle and District Electric Lighting Company, Limited.

The thirteenth ordinary general meeting was held on 13th inst. at Newcastle, Mr. J. D. Milburn presiding.

The annual report of the directors states:—

The directors have pleasure in again reporting that the supply of current continues to give satisfaction to the company's consumers. The installations connected to the company's mains during the year are equal to 5,600 10-C.P. lamps, bringing the total up to about 41,578, and 1,008,622 units of electrical energy have been supplied, as against 778,828 units supplied in 1898. During the past year 3,433 yards of main and branch piping have been laid, together with 9,768 yards of main and branch cable. The gross earnings during the year amount to £8,811 7s. 9d., and after paying interest and placing £1,000 to reserve and making provision for depreciation, your directors are able to recommend a dividend of 5 per cent. for the half-year ending December 31st (less income-tax) which, together with the interim dividend paid in August last, makes the dividend 8½ per cent. for the year. Mr. John D. Milburn and the Hon. C. A. Parsons retire by rotation, but are eligible, and offer themselves for re-election as directors. The auditors, Messrs. Strachan & Co, also offer themselves for re-election.

The Chairman congratulated the shareholders on the good progress that had been made in the work of the company. It they went back no further than the previous year, their output of current, represented by units sold, was 778,628, and in the year just closed it was 1,008,672 units, which was the largest increase they had had in any one year. The increasing demand had made it necessary for them to look out for further ground and further productive power, and they had been fortunate enough to obtain a site by the river side, between the High Level and the Redheugh Bridges; and, being unable to rent it, they had bought it. As soon as they got possession, which would be in a few months, they would commence work there, to supplement their present works. The new site was the nearest available one to their present site, which was at the bottom of the Forth Banks. The new site had a river frontage of 300 feet, and that enabled them to get the water for condensing, which was a very important matter in the cost. It also enabled coals to be delivered from craft right away to the boiler furnaces by means of mechanical conveyors. The area of the site was more than 4,000 yards, and, according to the present designs, the plant would be able to deal with 14,000 E.H.P.—that was to say, it would be possible to instal plant to that extent. They had already made contracts for the supply of 400 E.H.P.; therefore they had already begun to draw upon the new premises, as far as work went. Even in making provision for the future, they found they could not go fast enough, and they had found it convenient and desirable to fit up a continuous current system, for supplying power to machinery, in their present works, so that they might supply power to customers whom they had hitherto been obliged to delay or refuse. For this reason they had found it necessary to increase the capital, and they would in a few minutes be asked to deal with that matter. The dividend had been produced in the face of the fact that several items were dearer, especially coal and stores of all kinds. Notwithstanding, the cost had been increased on the previous year, when they had cheap contracts. As far as the outlook went, they had a large future before them; and he hoped that would not be the last time when they would have an extraordinary general meeting to confirm the authorisation to issue new capital. He moved that the report be adopted, and that a dividend be paid of 5 per cent. for the half-year ending December 31st, making the dividend 8½ per cent. for the year with the interim dividend paid in August last.

The motion, which was adopted, the retiring directors and auditors re-elected.

At the conclusion of the ordinary meeting, an extraordinary meeting was held, and Mr. Thomas Scott moved:—"That the capital of the company be increased to £200,000 by the creation of 10,000 ordinary shares of £10 each."

The Chairman explained that new shares would be issued at par to the existing shareholders, *pro rata*—each holder of shares being offered shares to the same amount as the shares he now held.

The motion was carried.

Cambridge Electric Supply Company.

The eighth annual meeting was held at Cambridge last week, Mr. D. Munsey presiding.

In moving the adoption of the report, the Chairman explained that they had had to increase the machinery so as to make themselves perfectly safe in meeting all the demands that might be made upon them. They had carried a larger amount to the depreciation account than on any previous occasion, and this year they hoped to clear off the preliminary expenses.

The Hon. C. A. Parsons seconded the motion, which was unanimously agreed to.

A motion was passed declaring dividend, after which

Mr. Swinton (managing director) said the directors had considered whether they could do something in order to get electric lighting taken up by some of the smaller houses and shops in the town where the proprietors did not care to go to the capital expense involved in putting in wires and fittings. They would shortly issue a circular throughout the town setting forth an arrangement whereby the company would be prepared to arrange for the wires and fittings to be put in a certain number of houses and shops without any first charge to the consumer. There would be 1d. per unit extra charge upon the amount of electricity and a minimum charge of 2s. per annum for each lamp.

The Hon. C. A. Parsons was reappointed a director, and Mr. Rutter auditor, of the company.

The Charing Cross and Strand Electricity Supply Corporation, Limited.

The report of the directors to be submitted to the shareholders at Maiden Lane on Tuesday, February 27th, at 12 o'clock noon, reads:—"In submitting the accounts for the year ended December 31st, 1899, the directors are pleased to report that the progress of the business has been very satisfactory. The Maiden Lane, Lambeth, and Short's Gardens stations, and the plant and machinery, have been maintained in a high state of efficiency. The equivalent of 48,453 additional 8-C.P. lamps, nearly double the number added in 1898, have been connected up to the mains of the Corporation during the past year, making a total of 182,689 lamps now connected. There have been 24½ miles added to the mains laid, making altogether 125½ miles. The sales of current from the stations of the Corporation have increased by 615,897 units during the year. The further extension of the Lambeth station is being carried out, and will shortly be completed, affording accommodation for an additional 2,500 H.P., and the requisite machinery and plant have been ordered. The installation in Short's Gardens is being proceeded with, and supply is now being given from that station. The large increase in the business during the past year, and the prospective requirements of the several districts supplied, will necessitate an increase of capital. A special meeting of the shareholders to consider this will therefore be convened at an early date. The provisional order to supply electric energy within the City of London, referred to in the directors' report for the year 1898, was granted to this corporation by the Board of Trade, and the order confirmed by Parliament. Some mains have already been laid in the western portions of the City, and supply given from the existing stations of the corporation. The directors have made arrangements for acquiring 7½ acres of freehold land at Bow. The greater portion will be devoted to the purposes of the City provisional order, which provides that a separate station shall be erected for the purposes of supplying the City. They, however, propose to reserve sufficient space to enable them to erect a separate installation should they find it expedient for the other purposes of the company. A Bill is being promoted in the present session of Parliament seeking statutory powers to lay mains from Bow to the City, and to enable the corporation to connect up with their stations; and to supply electric energy in bulk to such of the local authorities *en route* as may desire it. The City Provisional Order further provides that separate accounts be kept of all receipts and expenditure. The directors are taking measures to comply with these requirements, and to enable them satisfactorily so to do it will probably be necessary either that separate capital be created in the existing company for the purposes of this order, or that another company be registered. These matters will be dealt with at the proposed special meeting. It will be seen from the accounts that the debenture debt has been reduced from £70,000 to £24,200, and the temporary loan of £57,500 has been paid off. The directors also point out that the total reserves of the corporation now amount to £137,267, nearly 40 per cent. on the total share capital. The net earnings, as shown in the revenue (No. IV.) account, have amounted to £27,677 17s. 11d. A sum of £3,451 5s. 7d. has been paid in respect of interest on debentures and temporary loans up to December 31st, 1899, and £6,708 9s. 5d. was distributed

as interim dividend, at the rate of 8 per cent. for the half-year ended June 30th, 1899. There remains a sum of £17,518 2s. 11d., which, added to the undivided profit of £3,292 1s. 5d. from the preceding year's account, makes £20,810 4s. 4d., which the directors propose to deal with as follows:—

To provide for dividend on 4½ per cent. preference shares (apportioned to December 31st, 1899)	£4,500 0 0	
To pay a dividend at the rate of £10 per cent. for the half-year ended December 31st, 1899, on the ordinary shares (making with the interim dividend paid in August, 1899, £9 per cent. for the whole year)	11,768 10 6	
And to carry forward	4,541 13 10	
	£20,810 4 4	

Mr. Geo. H. Brougham Glasier and Mr. John M. Gatti are the directors who retire by rotation, and being eligible, offer themselves for re-election. The auditors, Messrs. O. R. Johnson & Son, also retire, and offer themselves for re-election.

Newcastle-upon-Tyne Electric Supply Company, Limited.

The directors' report read:—

The directors have pleasure in presenting the balance-sheet and profit and loss account for the year ending December 31st, 1899, and in stating that the units sold show an increase for the year of 163,309; the total being 967,098 as against 803,789 in the year 1898.

The total profits of the year's trading amount to..			£8,177 16 10
against which has been written off—			
Special expenditure on the re-construction and enlargement of dynamos	£800 9 11		
Costs incurred on Parliamentary matters	875 16 11		
		1,676 6 10	
leaving a balance of..		6,501 10 0	
Adding to this the balance brought forward from last year of		994 0 2	
there is a sum to be dealt with of		7,495 10 2	
Out of this amount an interim dividend of 4 per cent. was paid in July last, and the directors now propose to pay a further dividend at the same rate, making in all 8 per cent. per annum, and absorbing	5,341 12 8		
and to increase the reserve and depreciation account by a further sum of	342 16 0		
		5,684 8 8	
carrying forward to next year a balance of		£1,811 1 6	

The reserve account after dealing with the above amount of £342 16s., and also the premiums received on shares issued during the year, will stand at £20,000. The necessary expenditure on capital to keep pace with the demand for current during the year, and to provide for a continuous current service has amounted to £28,518 1s. 2d. The continuous current service referred to in last year's report is nearing completion. A Bill is being promoted in Parliament, which has been approved by the shareholders at extraordinary meetings, held on the 25th ult., and 12th inst., by which further powers will be conferred on the company with a view to the necessary extension of its operations. A provisional order for supplying Gosforth with electricity is also being applied for. In order to meet the expenditure already incurred, and that which will be required to carry out the above schemes, the sanction of the company will be asked to increase the nominal capital by £200,000, the new capital to be issued from time to time upon the terms of the resolution which will be submitted to an extraordinary general meeting in accordance with the Articles of Association. The retiring directors are Mr. T. G. Gibson and Mr. J. H. Armstrong, who are eligible and offer themselves for re-election. The auditor, Mr. Thomas Harrison, also retires, and is eligible for re-election.

At the conclusion of the ordinary meeting, held at Newcastle yesterday, an extraordinary general meeting was held, at which the following resolution was submitted:—

That this general meeting of the Newcastle-upon-Tyne Electric Supply Company, Limited, sanctions the creation by the directors of £200,000 additional capital, to be divided into 30,000 preference shares of £5 each, and 10,000 ordinary shares of £5 each.

Kensington and Knightsbridge Electric Lighting Company.

Mr. Granville R. Ryder presided on Wednesday afternoon at 1, Great George Street, Westminster, S.W., over the thirteenth ordinary general meeting of the above company, and, in moving the adoption of the report, said the board were pleased to be able to submit such a satisfactory balance-sheet. No doubt in some respects that had been rather an ideal electrical winter, because they had had plenty of fog and dark days, and there had been considerably more electricity used, but apart from such an advantageous occurrence, there had, no doubt, been a considerable spurt in the business, and, what was more, it was a progressive increase. They would see that the increase in the number of shops and houses which took the light in the year was 259, while in the previous year the number was 231. Then with regard to the lamps, of which there were 183,462 in the district, there was an increase of 27,304 in 1899, against an increase in the preceding year of 18,205. The gross receipts in 1899 were £53,055, while in 1898 they were £46,331, an increase of £6,724, as against an increase of £2,614 in the year 1898. The net profit during the year 1899 was £19,201 7s. 7d., and in 1898 it was £14,564 9s. 8d., which was a satisfactory increase. With regard to units sold, they were 2,463,950, which represented an increase for the year of 382,876 units, or nearly 400,000 units, which was a very large increase. In 1898 the increase, as against 1897, was 182,712 units; but apart from that there was one very satisfactory feature, and that was the very small increase in the cost of producing that increased quantity of electricity. With regard to coal, he thought there was special credit due to their chief engineer and his staff, for he managed to produce that extra amount of electricity at an increased cost of £1 11s. 6d. in the year, and if they took the whole cost of the generation of the electricity, it amounted to £16,830 17s. 11d. as against £16,571, or an increase of about £313 With regard to the renewal account, they had placed £4,000 odd to that account, which now brought it up to £30,339, and that they considered to be a very satisfactory figure. In the earlier years of the company, when they went into percentages of depreciation, they could only go upon estimates, but now they had had considerable experience, and knew what it ought to be, and that figure represented what experience had shown should be the right percentage for depreciation. With regard to the conversion which had been going on for some years, it had made steady progress in the past year, and now two-thirds of their customers had their houses wired to carry 200 volts and the other third they hoped to complete that year. They had issued new capital during the year, but they had spent a certain sum of money on capital account, which remained from former years. There would be a considerable amount of capital required next year if there were a good many things to be done. By the balance of the second preference shares being subscribed, they had been enabled to get a Stock Exchange quotation, for their capital had been increased to £170,000, while the nominal capital was £300,000. With respect to the new station which the company and the Notting Hill Company had power to erect, they were making good progress, and a number of contracts had been entered into. Two members of each board formed a committee to work it. The money raised for the works would be separate from the two companies, but the idea at present was to borrow the whole of the money from an insurance company.

Sir F. Bramwell seconded the motion, and it was carried.

Mr. Wallace asked if the company had powers under its articles of association to raise money by guarantee.

The Solicitor said it had, because that point was settled when the Bill was applied for.

The National Electric Supply Company, Limited, Preston.

The ordinary general meeting of this company was held at Preston last week. The chairman, Mr. J. Booth, in moving the adoption of the report and accounts, congratulated the shareholders on the continued improvement in the company's position and the increased value of their property. He said that the last year had been a very busy one, not only in connecting up a large number of new consumers, but also in providing extensions of machinery and plant for the future. Mr. Brown seconded the motion, which was carried unanimously. It was resolved on the motion of the chairman, seconded by Mr. Curwen, that the following dividends be declared:—4 per cent. for the year on the preference shares, and 4s. 6d. per share on the ordinary shares for the last half-year, which, with the interim dividend already paid, makes 7s. per share for the year.

The Wireless Telegraph and Signal Company, Limited.

This company meets to-day at Cannon Street Hotel. The ordinary meeting will be followed by an extraordinary general meeting when the subjoined resolutions will be proposed:—

(1) That the name of the company be changed to that of Marconi's Wireless Telegraph Company, Limited; (2) that the following article shall be substituted for Article No. 68 of Articles of Association of the company, viz., "The remuneration of the directors shall be the sum of £1,000 per annum, and in addition thereto, in any year in which the dividend or dividends declared and paid on the ordinary shares of the company shall be in excess of the rate of 7 per cent. per annum, the remuneration of the directors shall, for every such year, be increased at the rate of £500 for every additional 1 per cent. paid in dividends on the ordinary shares in excess of 7 per cent per annum; but so that in no case shall the entire remuneration of the directors for any one year exceed £9,000; and the remuneration shall be divided between the directors in such proportions as they may from time to time determine."

Telegraph Construction and Maintenance Company, Limited.

The report for the past year shows a net profit of £82,828, after charging the interest on the debentures. To this sum must be added £38,205 brought forward, making a total of £121,033. From this amount is deducted the interim dividend of 5 per cent, paid in July, amounting to £22,410, leaving £98,623 to be dealt with. Of this sum the directors propose to distribute a dividend of £1 4s. per share, absorbing £44,820, being at the rate of 10 per cent., and making, with the amount already paid, a total dividend for the year of £1 16s. per share, or 15 per cent., tax free, leaving £53,803 to be carried forward. The directors propose to add a further sum of £5,000 to the pension fund established last year for the benefit of the company's staff.

Windsor Electrical Installation Company.

The fourth annual report of the directors of the Windsor Electrical Installation Company, which will be presented at the annual meeting on March 7th, shows that the total dividend on the year is 8 per cent., and during the last 12 months the number of lamps have been increased by nearly 6,000 c.p. New machinery has been laid down to meet the increased demand for the light, and 10 miles of mains have been laid, covering the whole of Windsor and Eton, the size of the mains being sufficient to meet the demand for private as well as public lighting.

Prospectus.

Subscriptions have this week been invited by the Buenos Ayres and Belgrano Electric Tramways Company, Limited, for an issue of £120,000 5 per cent. second debenture stock (part of a total authorised issue of £200,000), at £97 10s. per cent. The proceeds are required to complete the electrification and equipment of the company's system, to provide for expenditure on new lines and increased rolling stock, and for general purposes. The gross receipts for last year amounted to £114,021. The list closed yesterday (Thursday.)

Stock Exchange Notices.—The Stock Exchange Committee has appointed a special settling day as under:—Wednesday, February 28th.—Hampstead Electric Supply Company, Limited.—6,360 ordinary shares of £5 each, fully paid, Nos. 1 to 2,652, 2,853 to 4,416 and 4,471 to 6,614; 8,038 5 per cent. cumulative preference shares of £5 each, fully paid, Nos. 1 to 5,330, 5,431 to 6,000, 15,763 to 16,912 and 16,918 to 17,905; 5,433 vendors' ordinary shares of £5 each, fully paid, Nos. 6,615 to 12,047; and 9,862 vendors' 5 per cent. cumulative preference shares of £5 each, fully paid, Nos. 5,331 to 5,430 and 6,001 to 15,762; and has also ordered the undermentioned securities to be quoted in the Official List:—London Electric Supply Corporation, Limited.—Further issue of £150,000 4 per cent. first mortgage debenture stock (redeemable), National Telephone Company, Limited.—Further issue of £670,529 3½ per cent. debenture stock.

Application has been made to the committee to appoint a special settling-day in and to grant a quotation to—British Electric Traction Company, Limited.—Further issue of 20,000 6 per cent. cumulative preference shares of £10 each, fully paid.

The Brush Electrical Engineering Company, Limited.—The directors, after placing the sum of £2,500 to depreciation reserve, have decided, subject to audit, to recommend payment of a dividend at the rate of 6 per cent. per annum on both the preference and ordinary shares of the company for the half-year ended December 31st, 1899, carrying forward a sum of about £5,000.

Imperial Tramways Company, Limited.—The directors have decided to recommend a dividend for half-year ending December 31st, 1899, at the rate of 8½ per cent. per annum.

Cape Electric Tramways Company.—It is announced that holders of share warrants to bearer can obtain payment of dividend by presenting coupon No. 5 at the offices of the company on or after 26th inst. An extraordinary general meeting will be held in London on 7th prox. to confirm the resolution altering articles 48, 50 and 77, which was passed on 14th inst.

National Telephone Company.—The meeting of this company was held yesterday at Cannon Street Hotel. Our report will appear next week.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending February 17th, 1900, were £99 16s. 5d.; receipts for corresponding period, 1899, £178 6s. 8d.; aggregate for half-year to date, £969 7s. 11d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending February 16th, 1900, were £2,217 0s. 6d.; corresponding period, 1899, £2,594 18s. 11d.; decrease, £377 18s. 5d. Heavy snowstorm, traffic partially suspended.

The City and South London Railway Company.—The receipts for the week ending February 18th, 1900, were £1,160; ditto February 19th, 1899, £1,089; increase, £73. Total receipts for half-year, 1900, to date, £7,898; corresponding period, 1899, £7,458; increase £40. Miles open, 3½.

The Dover Corporation Tramways.—The receipts for the week ending February 17th, 1900, were £131 8s. 11d.; February 18th, 1899, £147 18s. 8d.; decrease, £16 4s. 9d. Total receipts to date, 1900, £1,028 15s. 2d.; corresponding period, 1899, £1,000 14s. 4d.; increase, £28 0s. 10d. Miles of track open, 1900, 3; 1899, 3. Car miles run, 1900, 4,500; 1899, 4,204. Number of cars, 1900, 11; 1899, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, February 16th, 1900, were as follows:—D. U. T. Co., horse cars, £47 1s. 7d.; ditto, electric cars, £2,710 19s. 7d.; D. S. D. Co., electric cars, £529 6s. 8d.; total, £3,287 7s. 10d.; corresponding week last year—D. U. T. Co., horse cars, £1,774 0s. 2d.; ditto, electric cars, £905 8s. 11d.; D. S. D. Co., electric cars, £689 19s. 5d.; total, £3,319 8s. 6d.; decrease, £31 15s. 8d. Aggregate to date, £23,075 0s. 6d.; aggregate to date last year, £21,546 12s. 3d.; increase to date, £1,528 8s. 3d. The mileage worked is 42 miles electrically, 2 miles by horses, as against 18 miles electrically, 26 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending February 18th, 1900, were £467; week ending February 22nd, 1899, £324; increase, £143. Number of cars, 1900, 28; 1899, 15. Total receipts to date, 1900, £26,927; 1899, £9,126. Miles of track open, 1900, 12; 1899, 6½.

The Liverpool Overhead Railway Company.—The receipts for the week ending February 18th, 1900, amounted to £1,243; corresponding week last year, £1,297; decrease, £54. Total increase in traffics for half-year to date, £1,087.

STOCKS AND SHARES.

Wednesday Evening.

The week's war news up to to-night has been so good that all round the Stock Exchange a general feeling of relief and "bullishness" is the feature of the markets. Considerations of a tightening money market were lost in the glow of delight produced by news of good import from Lord Roberts and General Buller. Naturally, the South African market has been the most elated. In other departments there is still some hesitancy as to whether the time is ripe for starting a general advance. Members of the Stock Exchange recall the bad news which on several occasions lately has followed cables of good tidings, and many of the more cautious brokers are advising their clients to wait a little longer before entering the markets: "the war," one hears it said continually, "is not yet over."

To this feeling of caution is due the fact that there is hardly a single movement in the electrical supply section. Beyond a fall in Metropolitans and City of Londons, the movements have been more in tone than price. The Metropolitan Company is still the subject of wordy warfare at every meeting of the Marylebone Vestry, some of whose members advocate inviting a competitor to enter the district, whilst others would make terms with the company by which the Vestry should take over all the plant, &c., within its own area either by purchase outright, or by renting it from the Metropolitan. Citys went dull upon pessimistic dividend anticipations.

In the railway department, most of the talk centres round the proposals of the underground companies with regard to electrifying the lines. Districts are now 29¾, and Metropolitan Consolidated stands at 111. Central Londons do not move, although the approach of the day when their experimental train shall be on the metals should have infused a little life into the inanimate market.

Last week we ventured to predict a new issue of £120,000 second Debenture stock at 97½ by the Buenos Ayres and Belgrano Electric Tramways Company. The prospectus of this duly appeared on Tuesday. The money is required to complete the electrification and equipment of the company's system, and for the company's general purposes. In 1910 the Debenture stock will be redeemable at 105. There is already an amount of £320,000 5 per cent. first Debenture stock quoted in the market, the price of which is 105 to 108, and the company's "A" Preference shares stand at 5 middle, while the "B" Preference are quoted 4 to 4½. Both the latter are £5 shares fully paid. There is a fair amount of business doing in British Electric Tractions, and a small premium has been established upon the company's new issue of 5 per cent. Debenture stock.

National Telephone Ordinary shares have shed another fraction, and the cause of the weakness is now apparent. A fresh issue of £1,000,000, half in second Debentures and half in Ordinary shares is about to be made, and certain people with early knowledge of the issue hastened to sell. The market, while it was prepared for an appeal for fresh capital owing to the company's position as disclosed by the last balance-sheet, hardly expected the new issue would be made so soon. As matters stand at present, the whole authorised capital of the National Telephone Company is 10½ millions sterling, of which 6 millions has been issued. The meeting being on Thursday, we are unable to comment upon it this week. Another company requiring more cash is the Edison & Swan United Electric Light, which will hold a meeting of shareholders on Tuesday next for the purpose of passing a resolution enabling the directors to issue Second Debenture stock. The price of the shares shows no alteration. At the meeting of the Westminster Supply Company to-day (Wednesday) Lord Suffield referred to the need of increasing the company's capital.

Brush Ordinary and Preference are both 2s. 6d. better upon the dividend of 6 per cent. per annum which has just been declared. The distribution on the Ordinary is ½ per cent. better than it was in 1898, and 2½ per cent. more than was paid in 1897. We are glad to see that £2,500 has been placed to depreciation reserve. Electric Constructions have also improved.

Turning to telegraph descriptions, Eastern Extensions have at last made a move, scoring ¼ on the week. This is mainly on account of the concessions which have been granted to the company by the Victorian Government. Eastern Ordinary is a point to the good, despite Mr. Chamberlain's observations in the House of Commons on Tuesday night anent the new Pacific cable, arrangements for the construction of which, he said, were being considered by a committee of representatives of the Imperial Government and the colonies.

Among the reports that the week has brought forth, the Charing Cross and Strand Company's is regarded as one of the most promising, showing as it does the large increase of business which is accruing to the undertaking. Again we have to note that fresh capital in connection with the new business will be required. A less satisfactory document is the report of the Motor Manufacturing Company, Limited. The accounts show a debit balance of £18,161 as the result of 22 months' trading. Plenty of hope is held out to the shareholders; we fear it is as much as they will get out of the concern for a long time yet. The Henley report, showing a net profit of £46,037 for last year, has not affected the price of the shares.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation, Feb. 14th.	Closing Quotation, Feb. 21st.	Business done during week ended Feb. 21st, 1900. Highest.	Lowest.
110,900	African Direct Telegraph, 4 % Debs.	100	...	...	...	99 —103	99 —103	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
875,520	Anglo-American Telegraph	Stock	3 %	£3 9s	73/6	63 — 66 xd	63 — 66	64	63½
3,062,240	Do. do. 6 % Pref.	Stock	6 %	6 %	6 %	114 —115 xd	114 —115	115	114
3,062,240	Do. do. Deferred...	Stock	...	18s. %	£1 7s	14½— 15 xd	14½— 15	14 15/16	14⅜
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	...	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	...	165 —175	165 —175	...	...
1,382,823£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	..	...	102 —104	103 —106	103⅜	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	1½ %	1 %	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	7 %	8 %	...	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	...	19 — 20	19 — 20	19	...
12,981	Direct Spanish Telegraph	5	4 %	...	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	...	...	9 — 10	9 — 10	...	...
80,000	Do. do. 4½ % Debs.	50	...	...	...	101—105%	101 —105%	...	...
60,710£	Direct United States Cable	20	3½ %	3½ %	3 %	11½— 12	11½— 12	11⅞	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	99 —102	99 —102	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	...	154 —159	155 —160	159	156
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	98 —101	98 —101	...	...
1,483,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	...	...	116 —121	116 —121	119	116
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	...	15½— 15¾	15½— 16	15⅞	15½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	...	...	99 —103	100 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	...	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	...	...	115 —120 xd	115 —120	115½	...
300,000£	Eastern and South African Telegraph, 4 % Mort. Deb., Nos. 1 to 3,000, red. 1909	100	...	...	...	100 —103	100 —103	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	...	...	...	101 —104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½%	5½%	...	11½— 11¾	11½— 11¾	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	...	15½— 16	15½— 16	15⅞	15⅝
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	...	...	30 — 32	31 — 33	...	...
86,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	99 —102	99 —102	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	...	49 — 53	49 — 53	52	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	...	...	106 —109	106 —109	...	...
72,680	Montevideo Telephone, Limited, Ord., Nos. 1 to 72,680 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
86,492	Do. do. 5% Pref., Nos. 1 to 86,492	1	4 %	4 %	2½ %	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	6 %	6 %	5 %	5⅜— 5⅝	5⅜— 5½	5½	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14⅜	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	6 %	5⅜— 5⅝	5⅜— 5⅝	5 9/16	...
1,339,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	5 %	98 —100	97 —100	99	97½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	3½ %	¾— 1	¾— 1	¾	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	...	...	101 —104	101 —104	...	...
11,839	Reuter's	8	5 %	...	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	124 —129	124 —129	...	...
58,000	United River Plate Telephone	5	5 %	6 %	6 %	4⅜— 5⅛	4⅜— 5⅛	...	...
16,639	Do. do. 5 % Cum. Pref. Nos. 1—16,639	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
179,947	Do. do. 5 % Debs.	Stock	..	...	...	103 —106	103 —106	...	...
200,000£	West African Telegraph, 5 % Debs.	100	%	...	...	98 —101	98 —101	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	100 —103	100 —103	...	...
389,731	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	100 —104	100 —104	...	...
205,993	Western Telegraph, Ltd., Nos. 1—205,993	10	...	...	...	14⅜— 15⅛	14⅜— 15⅛	15⅛	14⅞
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	106 —109	106 —109	...	...
88,321	West India and Panama Telegraph	10	⅝%	...	...	¾— 1⅛	¾— 1⅛	1	...
34,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	...	...	9½— 9¾	9½— 9¾	9⅛	9½
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	...	...	7 — 8	7 — 8	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	...	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	...	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	4 %	6 %	...	7 — 8	7 — 8	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	...	...	8½— 9½	8½— 9½	...	...
30,000	Charing Cross and Strand Electricity Supply	5	7 %	8 %	9 %	10 — 11	10 — 11	...	...
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	10 — 11	10 — 11	10 7/16	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6½	5⅜— 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	6 %	6 %	...	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	...	...	110 —112	110 —112	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	10 %	6 %	...	10½— 11½	10½— 11½	11	10⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	...	13 — 14	13 — 14	14	13½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	...	...	122 —127	122 —127	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	...	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	...	12½— 13½	12½— 13½	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	108 —111	109 — 112	110½	110
26,100	Edmundsons Elec. Corp., Ord. Shares	5	5 %	7 %	...	4⅜— 5½	4⅜— 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	8	...	...	...	1¾— 2¼	1¾— 2¼	...	...
48,050	Do. do. do. 6 % Pref.	5	...	6 %	...	4½— 5	4½— 5	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	101 —108	101 —103	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	6 %	5 %	...	14½— 15½	14 — 15	15¼	14¾
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
230,000§	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	...	...	114 —117	114 —117	...	...
125,000	Do. 3½ % Mort. Deb. Stock Red.	Stock	...	...	...	95 — 97	95 — 97	96½	...
6,452	Notting Hill Electric Lighting	10	6 %	6 %	7 %	16 — 17	16 — 17	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	15 — 16	15 — 16	15⅝	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4 — 4½	4 — 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	12 %	12 %	13 %	14 — 15	14 — 15	14⅜	...

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1897.	1898.	1899.	Closing Quotation Feb. 14th.	Closing Quotation Feb. 21st.	Business done week ended Feb. 21st, 1900. Highest.	Lowest.
		‡							
65,000	Aluminium shares, Nos. 1—65,000	1	10 %	...	...	2⅞ — 3⅛	2⅞ — 3⅛	3	2⅞
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	96 —100	99½	...
30,000	British Electric Traction	10	...	6 %	...	16 — 17	16 — 17	16⅝	16½
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½ — 13⅝xd	13½ — 13⅝	13⅝	13½
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	125 —128	...	...
45,000‡	†British Electric Works Co., Ord. £1 shares, 50,001—95,000		...	...	...	1 — 1⅛	1⅛ — 1 1/16	...	...
50,000	† Do. do. 6 % Cum. Pref., 1—50,000 ...		...	...	...	⅞ — 1	⅞ — 1	...	...
500	† Do. do. 4½ % 1st Mort. Deb.	100	...	...	...	... ...	99 —101	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	20 %	13 — 14	13 — 14	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6 — 6⅛	6 — 6⅛	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	3 %	5 %	...	1⅞ — 2	1⅞ — 2	1 1/16	1⅞
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅜	...	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —105	102 —105	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	12½%	15 %	...	13½ — 14½	14 — 15	14½	14½
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½ — 6	5½ — 6	5⅞	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	110 —115	110 —115	...	...
213,533	Central London Railway, Ord. Shares	10	...	...	...	9½ — 10	9½ — 10	10⅛	9⅝
61,033	Do. do. Pref. half-shares	5	...	...	...	4½ — 5	4½ — 5	...	...
71,447	Do. do. Def. do.	5	...	...	...	4½ — 5	4½ — 5	...	...
855,000	City and South London Railway	Stock	1⅞%	2⅛%	1⅞%	58 — 61 xd	58 — 61	60½	59¾
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000 £5 10s. pd.	10	...	...	...	4 — 5	4 — 5	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½ — 4	3½ — 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	98 —101	98 101	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	6 %	6 %	...	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	6 %	6 %	...	3½ — 4⅛	3½ — 4⅛	...	...
344,023	Do. do. 4 % Deb. Stock Red. ...	100	...	...	...	93 — 95	93 — 95	93½	...
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	...	2⅛ — 2⅜	2⅛ — 2⅛	2⅜	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	...	2⅞ — 3⅛	2⅞ — 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600‡	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	12 %	14 %	...	13½ — 14½	14 — 15	14⅜	...
12,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	...	5½ — 6	5½ — 6	5 1/16	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	...	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	...	21 — 22	21 — 22	21¾	...
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
87,500	†Liverpool Overhead Railway, Ord.	10	3½%	3½%	3½%	9 9/16 — 9 11/16	9½ — 9⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13½	12⅝ — 13½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	39	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	102 —105	102 —105	103	...
20,000	Telegraph Manufacturing, Ord. Nos. 1 to 20,000	5	...	...	...	9 — 10	9 — 10	9¼	...
20,000	Do. do. 5% Cm. Prf. Nos. 1 to 20,000 ...	5	...	...	...	5½ — 6	5½ — 6	...	...
540,000‡	Waterloo and City Railway, Ord. Stock	100	...	3 %	3 %	101 —104 xd	101 —104	104	1 2

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½ % Debentures of £100, 107—108.
National Electric Free Wiring, 12/6 paid. ⅜—½.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10½—10¾.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6 % £5 (fully paid), 7⅛—8. Debentures, 103—106. Dividend, 1899, on Ordinary Shares 11 %.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 4 per cent. (January 25th, 1900).

MARKET QUOTATIONS, Wednesday, February 21st.

CHEMICALS, &c.		This week.	Last week.	Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a ,, Nitric	per cwt.	22/-	22/-	..
a ,, Oxalic	per cwt.	22/-	22/-	..
a ,, Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	£29	..
a ,, ,, ...	per ton	£27	£27	..
a Bleaching powder	per ton	£7	£7	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a ,, (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25	£25	..
a Lead, Nitrate	per ton	£25	£25	..
a ,, White Sugar	per ton	£31	£31	..
a ,, Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 150° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4½d.	4½d.	..
a ,, Caustic (75/80 %) ..	per ton	£24	£24	..
a ,, Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a ,, Recovered	per ton	£5 10	£5 10	..
a ,, Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	£10 15	..
a ,, Crystals	per ton	£3	£3	..
a ,, Bichromate, casks ..	per lb.	3¾d.	3¾d.	..
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b ,, Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£85 to £145	£85 to £145	..
c Brass (rolled metal 7' to 12') basis	per lb.	8d.	8d.	..
c ,, Tube (brazed)	per lb.	10d.	10d.	..
c ,, ,, (solid drawn) ..	per lb.	..	9d.	..
c ,, Wire, basis	per lb.	8½d.	8½d.	..
c Copper Tubes (brazed)	per lb.	..	11½d.	..
c ,, ,, (solid drawn) ..	per lb.	..	11½d.	..
g Copper Bars (best selected) ..	per ton	£86	£84	£2 inc.

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
g Copper Sheet	per ton	£86	£84	£2 inc.
g ,, Rod	per ton	£86	£84	£2 inc.
e ,, (Electrolytic), Bars ..	per ton	£93	£92	£1 inc.
e ,, ,, Sheets..	per ton	£93	£89	£3 inc.
e ,, ,, Rod ..	per ton	£86	£85	£1 inc.
e ,, ,, H. C. wire	per lb.	9¼d.	9¼d.	..
f Ebonite Rod	per lb.	2/-	2/-	..
f ,, Sheet	per lb.	5/-	5/-	..
n German Silver Wire	per lb.	1/8	1/8	..
h Gutta-percha, fine	per lb.	8/-	7/-	1/- inc.
h India-rubber, Para fine ..	per lb.	4/6½	4/5½ to 4/6	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i ,, Pig (Cleveland warrants)	per ton	60/9	60/4½	4½d. inc.
i ,, Forgings, according to size	per ton	From £11	From £11	..
i ,, Scrap, heavy	per ton	70/- to 72/6	70/- to 72/6	..
i ,, Wire galvanized No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£16 11 8 to £16 12 6	£16 13 6	..
g ,, ,, Sheet	per ton	£18	£18	..
m Manganin Wire No. 20.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 12	6d. inc.
d Mica (in original cases), small	per lb.	3d. to 9d.	3d. to 8d.	1d. inc.
d ,, ,, ,, medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d ,, ,, ,, large	per lb.	3/3 to 7/3	3/6 to 7/6	3d. dec.
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, r'l'd str'p & sheet	per lb.	From 1/8	From 1/8	..
c Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/	10½d to 1/	..
i Steel, Magnet, ace'd'g to desc'p'n	p. ton	From £15 to £40		..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£148 to £149 nom.	£140 10 to £141 10 nom.	£8 inc.
g ,, foil	per lb.	1/9	1/9	..
n ,, wire Nos. 1 to 16	per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
f Yarns, Cotton, Single 10lb. bundles	pr lb.	7¼d.	7¼d.	..
f ,, Best Flax, 6 lea. ..	per lb.	5½d.	5½d.	..
f ,, Hemp, 8 ply 10 lbs. ..	per lb.	4½d.	4d.	½d. inc.
f ,, ,, Russian, 10 lbs.	per lb.	5d.	4½d.	½d. inc.
f ,, Jute, 180 lbs. rove ..	per ton	£15	£14 10	10s. inc.
k Zinc, Sheet (Vielle Montagne brd.)	p.t.	£37 5 nett.	£37 5 nett.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e Frederick Smith & Co.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lewis.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

INSTITUTION OF ELECTRICAL ENGINEERS.

THE STANDARDISATION OF ELECTRICAL ENGINEERING PLANT.

By R. Percy Sellon, Member.

Paper read February 8th, 1900.

(*Concluded from page 288.*)

6. It is not possible to enter in this paper upon the consideration of the actual formulæ which might constitute standards for the future. This is a very large and important question, demanding much careful thought and discussion. The machinery for this purpose already exists, at any rate as a nucleus, in the Uniformity Committee of this Institution, appointed shortly after the submission of a highly suggestive paper on "Uniformity of Plant," by Mr. C. H. Wordingham, before the Municipal Electrical Association in the summer of 1898. But beyond a word of advice on the subject of standard periodicities, nothing has so far issued publicly from the deliberations of this Committee, extending over 18 months. At this rate we may become irretrievably committed to many steps which all may live to regret, before effective results are obtained; for an unexampled expansion in every department of electrical engineering, notably those of electric traction and of power distribution over extensive areas, appears about to take place in this country.

The author ventures to suggest that additional weight and acceleration to the work of the Committee of the Institution would be given if it were strengthened by the addition of representatives of all interests concerned, viz, those of the manufacturer, user, consulting engineer, and user's engineer. The Institution might also encourage the submission of papers suggestive of standards for various classes of electrical engineering plant and accessories. These, together with the views which would be brought out in discussion, would serve as a valuable guide to a representative committee.

In conclusion, the propositions which the author has endeavoured to establish may be briefly recapitulated as follows:—

(*a*) Standardisation, to a greater degree than at present exists, is in the interest of the manufacturer; as a means of facilitating repetition production and of meeting the competition of standardised foreign manufactures.

(*b*) Standardisation of "ends" or "performance" as distinct from "means" or "constructional details" is equally in the interest of the user; by securing for him low purchase cost, prompt delivery, freedom from the risks of experimental design, and full manufacturer's guarantees.

(*c*) The relative absence of standardisation in Great Britain, in contrast with other countries, is mainly traceable to the prevailing system wherein the user's engineer specifies "means" or "constructional details," instead of confining himself to "ends" or "performance."

(*d*) The determination of standards by organised effort, rather than by the slow and costly process of "trial and error," is desirable, and should be undertaken under the auspices of the Institution of Electrical Engineers, as representing the interests of both producer and user.

P.S.—The accompanying table of central stations in Great Britain, with particulars of system, periodicity, generating pressure, and distributing pressure employed, is adduced for the convenience of members.

Table showing System in Periodicity, Generating Pressure and Distributing Pressure in the Central Stations of Great Britain.

Name of station.	System.	Periods.	Generating pressure.	Pressure at lamps.
		~	Volts.	Volts.
Aberdeen	Direct three-wire	..	448	230
Aberystwith	Alternating	100	2,050	100 & 200
Alderley Edge	Direct three-wire	..	420—460	210
Altrincham	Alternating	80	2,000	100
Ashton-under-Lyne	Direct three-wire	..	440	200
			Traction 550	
Ayr	Alternating	60	2,100	100 & 200
Barking	Direct three-wire	..	460—500	220
Barnsley	Do.	..	450	230
Barrow	H. T. continuous	..	1,100	220
Bath	Alternating	100	2,000	100
Bedford	Do.	60	2,000	100
Belfast	Direct three-wire	..	440—500	220
Bexhill	Do.	..	440	..
Birkenhead	Do.	..	460	230
Birmingham	Alternating	50	..	110 & 220
Blackburn	Direct three-wire	..	2,000	110 & 220
Do.	Alternating	..	220—250	110 & 220
Blackpool	Do.	83	2,000	200
Bolton	Do.	83	2,000	100
Bournemouth	Direct three-wire	100	2,200	100 & 200
Bradford	Alternating	..	250 & 500	220
Bray	Direct three-wire	60	1,000	100
Brighton	Alternating	..	800	115 & 220
Do.	Do.	70	2,400	115 & 220
Bristol	Direct three-wire	98	2,050	105 or 210
Burnley	Alternating	..	220—240	220
Burton-on-Trent	Direct three-wire	75	2,000	100
Bury	Alternating	..	220	220
Cambridge	Direct three-wire	90	2,000	100 & 200
Canterbury	Alternating	..	440	220
Cardiff	Direct three-wire	40	2,500	100 & 200
Charing Cross Co.	Do.	..	100 & 1,000	100 & 200
Carlisle	Alternating	100	460	230
Chatham	Do.	100	2,400	100
Chelmsford			2,100	100
Chelsea	Direct three-wire	~	Volts.	Volts.
Cheltenham	Alternating	..	..	100 & 200
Chester	Direct three-wire	98	2,200	100 & 200
Chislehurst	Do.	..	440	210
	Using motor-alternator and buying H. T. energy	..	420	210
City of London	Alternating	100	2,000	100 & 200
Coatbridge	Do.	100	2,080	100
Colchester	Direct three-wire	..	220	105
Cork	Do.	..	500	220
County of London	Alternating	100	2,100—2,300	100
	Direct	..	580	Power 510
Coventry	Alternating (2-phase)	50	2,100—2,200	200
Croydon	Alternating	87	2,000	200
Crystal Palace Co.	Do.	60	2,000	200
Darwen	H. T. direct	..	1,000—1,100	100
Derby	Direct three-wire	..	460—500	230
Dewsbury	Alternating	40	2,000	102 & 205
Dover	Direct three-wire	..	250	110 & 250
	Alternating	100	2,000	100
Dublin	Direct (tramway)	..	500	500
Dundee	Alternating	83	2,100	100
Ealing	Direct three-wire	..	230	200
	Alternating	40	2,000	102
Eastbourne	Series D.C. arc lighting	..	1,800	100
	Alternating	83	1,800	100
Eccles	Series D.C. arc lighting	..	..	..
Edinburgh	Alternating	50	2,000	200
	Direct three-wire	..	..	115 & 220
Exeter	Alternating	50	2,100	..
	Do.	100	2,000	100
Folkestone	Series D.C. arc lighting	..	1,600	..
Galway	Direct three-wire	..	460	230
Glasgow	Direct	..	180	110
Gloucester	Direct three-wire	500 & 600	250	
Guildford	Direct	..	250	..
Halifax	Alternating	80	2,000	200
	Direct for tramways and power	..	..	..
Hammersmith	Alternating	50	2,200	110
Hampstead	Do.	90	2,000	100—105
Hanley	Series D.C. arc lighting	..	1,800	..
	Alternating	100	2,000	200 & 100
Harrogate	Series D.C. arc lighting	..	1,500	..
Harrow	Alternating	50	2,000	200 & 100
Hastings	Direct three-wire	..	470	230
Hove	Alternating	100	2,000	100 & 200
Huddersfield	Direct three-wire	..	220	220
Hull	Alternating	100	2,000	100 & 200
	H.T. & L.T. direct	..	2,250, 450 & 225	110 & 220
Islington	Alternating	50	2,000	100 & 200
Kelvinside	Direct	..	150	100
Kensington & Brompton	Alternating	..	2,000	100
Kensington and Knightsbridge	Direct three-wire	..	110 & 220	100 & 200
Keswick	Alternating	75	2,000	..
Killarney	Do.	100	2,000	100
Kingston-on-Thames	Do.	77	2,100	105
	D.C. Arc lighting	..	1,000	..
Lambeth	Alternating	..	..	..
Lancaster	Direct three-wire	..	240 & 120	200 & 100
Larne	Alternating	100	2,200	100
Leamington	Direct	..	118	..
Leeds	Alternating	83	2,000	100 & 200
Leicester	Do	50	2,000	100 & 200
Leith	Direct three-wire	..	460	230
Leyton	Do.	..	..	150
Lincoln	Do.	..	460	230
Liverpool	Direct	..	..	220
Llandudno	Direct three-wire	..	440	220
London (part)	Alternating	83	10,000	..
Londonderry	Continuous arc lighting	..	3,000	..
Manchester	Direct multi-wire	..	460	100, 200, 300 or 460
Metropolitan Co.	Alternating	..	..	200 & 100
Middlesbrough	Direct three-wire	..	..	200 & 100
Monmouth	Direct	..	440	..
Morecambe	Alternating	60	3,000	190
Morley	Direct	..	1,400	220
Nelson	Alternating	60	2,000	200
Newcastle-on-Tyne (part)	Direct	..	120	112
	Alternating	100	2,000	100
Newington	Do.	80	1,000	100
Newmarket	Direct three-wire	..	450—500	220
Newport	Do.	..	420—460	210
Northampton	Alternating	87·5	2,000	100
Norwich	Direct three-wire	..	220	105 & 210
Nottingham	Do.	..	250	110 & 220
Notting Hill	Do.	..	220	100 & 200
Oldham	Do.	..	200	100 & 200
Oswestry	Direct	..	..	210
Oxford	Direct	..	220	220
Paisley	Direct	..	1,000	100
Pembroke	Alternating	50	3,000	200
Plymouth	Direct three-wire	..	250	..
	Alternating	50	2,000	200 & 100
Pontypool	Direct for tramways	..	500	500
Poplar	Direct	..	185	100
Portsmouth	Direct	..	450—570	..
Prescot	Alternating	50	2,000	100
Preston	Do.	100	2,000	100
	Direct three-wire	..	220 & 250	110 & 220
Rathmines	Alternating	50	2,000	220
Reading	Direct three-wire	..	250	..
	Alternating	67	2,000	100 & 200
Richmond	Direct three-wire	..	400—450	100 & 200
Rochdale	Do.	..	115—220	110 & 220
St. Helens	Do.	..	440—480	..
	Alternating	60	2,000	100 & 200
St. James', Westminster	Direct three-wire	..	460	230
St. Pancras	Do.	..	..	107
Salford	Do.	..	..	110 & 220
	Alternating	75	3,000	..
Salisbury	Direct three-wire	..	450	210
Scarborough	Alternating	80	2,000	100 & 200
Sheffield	Do.	100	2,050	100 & 200
Shoreditch	Direct	..	1,100	..
Shrewsbury	Direct three-wire	..	420	210

Name of station.	System.	Periods.	Generating pressure.	Pressure at lamps.
		~	Volts.	Volts.
Southampton	Do. ..	..	230	100 & 200
	Alternating	50	2,200	100 & 200
Southport	Do. ..	50	2,100	100 & 200
South Shields	Do. ..	50	2,000	110 & 220
Stafford	Direct three-wire ..	..	108 & 216	105 & 210
Stockport	Do. ..	..	460	230
Sunderland	Do. ..	..	440	110 & 220
Swansea	Do. ..	..	440	..
Taunton	Alternating	..	2,000	100 & 200
Torquay	Do. ..	50	2,100	200
Tunbridge Wells.. ..	Do. ..	68	2,100	220
Ventnor	Direct three-wire ..	..	420—460	210
Wakefield	Alternating	60	2,000	200
Wallasey	Do. ..	50	2,000	100
Walsall	Direct	..	2,000	105
Watford	Alternating	50	2,100	200
West Ham..	Do. ..	50	2,000	100
Westminster	Direct three-wire ..	..	235	100 & 200
Whitehaven	Do. ..	..	210—240	100
Wimbledon	Alternating	50	2,200	..
Winchester	Direct three-wire ..	..	420—460	210
Woking	Alternating	100	2,000	100
Wolverhampton	Direct	..	2,000 & 460	110, 220 & 440
Woolwich	Direct three-wire ..	..	420	..
Worcester	Alternating	100	2,200	100
Wycombe	Direct three-wire ..	..	420	210
Yarmouth	Alternating	83·5	2,000	100

Number of direct current three-wire stations = 73
" " direct current high tension " = 9
" " alternating current " = 62
" " combined A.C. and D.C. " = 16

Periodicities:—

~ =	100,	98,	90,	87,	83,	80,	77,	75,	70,	67,	60,	50,	40.
Number of stations	20,	2,	2,	2,	7,	4,	1,	3,	1,	2,	8,	20,	3.

Alternating Current Generating Voltages:—

10,000 V.,	3,000 V.,	2,600—2,400 V.,	2,200—2,000 V.,	1,800—1,600 V.,	1,000 V.
1	2	2	66	1	1

THE ACTION OF ELECTRIC TRAMWAY CURRENTS ON SUBMARINE TELEGRAPH CABLES AND OTHER ELECTRIC CIRCUITS.*

By Prof. ANDREW JAMIESON, F.R.S.E. (Member).

Having been asked to give a short account of my visit to Cape Town last year, I have only to mention that the subject of my remarks has to deal with one of the many causes of delay in the transmission of telegrams, in order to ensure your close attention.

Present and Future Cable Routes to the Cape.

By referring to the map, it will be seen that there are at present two telegraph routes to the Cape from this country, the one and the older route being termed the "Eastern and South African," and the other the "West African." Both routes are worked by, and have their basis in, the first portion of the Eastern Telegraph Company's system. Messages for the Cape by the Eastern lines go from London *vid* Porthcurno, Lisbon, Gibraltar, Malta, Alexandria, Suez, and Aden, where they branch off down to Zanzibar, Mozambique, Delagoa Bay (Lorenço Marques), and Durban. From thence they are transmitted by the Government landlines to Cape Town, &c. The cables from Aden to Durban were laid in 1879, at the time of the Zulu War, and only one section thereof has since been duplicated, viz., that between Zanzibar and Mozambique, in 1885. I have always been particularly interested in this 1879 cable, since I had to effect the first repair upon it, just south of Mozambique, in the Spring of 1880, owing to its having been broken by a submarine earthquake!

The West Coast route returns to Great Britain *vid* Mossamedes, Loanda, and many other places, such as Lagos, Bathurst, St. Vincent, Madeira, and Lisbon.

With the view of providing additional security to submarine telegraph communication between this country and South Africa, landing rights at Cape Town have been obtained from the Government by the Eastern Telegraph Company for a third cable. The first section, from Cape Town to St. Helena, was completed on November 26th, and a further section to the Island of Ascension on December 16th last year. The continuing cables to be laid to St. Vincent, Madeira, and Great Britain are now being manufactured. It is further expected that this much more direct cable will be extended from the Cape to Australia, and that the tariff will be considerably reduced.

At the end of last July I was requested to proceed to Cape Town for the purpose of acting as one of the advisers to the Cape Electric Tramways Company in an action brought against it by the Eastern Telegraph Company. This action was raised owing to disturbances in the working of the submarine cables landed at Cape Town by the operations of the neighbouring electric tramways. I had an able colleague in Mr. Frank Jacob, the chief electrician and technical adviser to Messrs. Siemens Bros. & Co., of London. On the outward voyage we had the advantage of studying the many Bills and Acts of the Cape Parliament relating to telegraphs and tramways, as well as Mr. A. P. Trotter's paper, which was read before the Institution of Electrical Engineers in 1897.* Upon our arrival at Cape Town we found that, although the Submarine Telegraph and Tramway Companies had willingly afforded every facility to experts for carrying out numerous and varied experiments, and although the former company had spent considerable sums of money in devising and executing plans for eliminating the vexatious electrical interferences, no perfect system had yet been adopted for thoroughly cancelling the disturbances, and consequently a considerable difficulty was still frequently experienced in deciphering the telegraphic signals.

How Submarine Cable Signal Currents are Transmitted, Received, and Returned to the Sending Station.

Looking at fig. 1, it will be seen that the + and − electrical impulses, which are set free from the sending battery by manipulating the double current key, charge (say + in the first case) the home side of the sending condensers, thereby inducing a − charge from the other side of the same and from the conductor of the cable. This naturally repels a + charge along the conductor of the cable to the receiving end, and charges the cable side of the receiving condensers +, inducing − on the opposite plates of the same, and repelling a + charge through the delicate Kelvin siphon recorder to the metal sheathing of the shore end. This current, as shown in fig. 1, finds its way back to the sending station battery, not only along the sheathing of the cable, but also

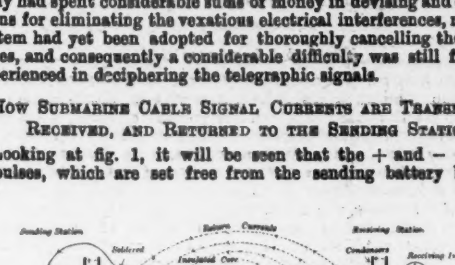


Fig 1.—The Ordinary Connections for the Working of Submarine Cables.

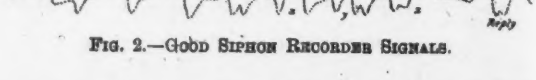


Fig. 2.—Good Siphon Recorder Signals.

very largely, if not almost entirely, through the sea water and the earth. The splitting up of the return current in this manner is due to the shore ends making intimate electrical contact with the water and earth.

Many electricians used to fancy, and even now fancy, that the return current passes back to the sending station *entirely* by the cable sheathing. I have, however, often proved that this is not the case by alternately connecting and separating the sheathing at an intermediate station without affecting the strength of the signals at either of the distant ends! It is important to note that the sending and receiving currents act by induction in and from the sending and receiving condensers. These condensers serve the double purpose of

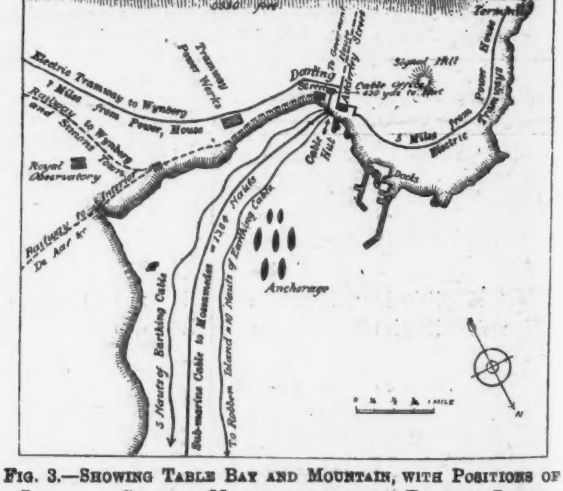


Fig. 3.—Showing Table Bay and Mountain, with Positions of Submarine Cable to Mossamedes and the Tramway Lines.

* Paper read before the Institution of Engineers and Shipbuilders of Scotland, February, 1900.

* See *Proceedings of the Institution of Electrical Engineers*, London, Vol. XXVI., page 501, for Mr. Trotter's paper on "Disturbance of Submarine Cable Working by Electric Tramways."

cutting off the interfering effects due to "earth currents," and of sharpening or defining the receiving signals (see fig. 2), thus enabling a greater speed of working to be attained than would be the case without them.

Relative Positions of the Submarine Cables and Electric Tramways Lines, &c., at Cape Town.

From fig. 3 it will be seen that the Cape Town shore end of the main submarine cable to Mossamedes (which was laid in 1889, and is 1,383 nautical miles in length) passes round the south-eastern curve of Table Bay in order to avoid the anchorage. Further, that a part of the electric tramway lines (which are worked on the overhead, trolley-wire system with the return circuit through the rails) pass from the power house towards Wynberg on the one side, as well as to and through Cape Town on the other side, and lie almost parallel to the submarine cable. In fact, the first mile of the shore end is only at a mean distance of about half-a-mile from the tramway line; whilst the subterranean line from the Cable Telegraph Office along Adderley Street to the cable house, a distance of 430 yards, lies for a certain distance thereof, quite close and parallel to the tramway rails. Ever since the opening of the electric tramway service on August 6th, 1896, the received signals at Cape Town from Mossamedes, or from Loanda a further distance of 530 nautical miles, have been seriously interfered with by the working currents of the tramway system. At first, the tramway lines only extended from the suburb of Mowbray to the corner of Darling Street and Adderley Street; but now, they are in full swing from the power-house to Wynberg, a distance of 7 miles to the left, and through Cape Town to Sea Point, a distance of 5 miles to the right. These extensions combined with the greatly increased traffic, and consequently increased strength of the working currents, have naturally augmented the amount and frequency of the disturbances. The Submarine Telegraph Company having been unprepared for such disturbances to its receiving signals, had its cables joined up exactly as depicted in fig. 1. At first, the company was evidently under the impression that the erratic kicks, vibrations, and splashes, produced on the recorder slip, as seen in fig. 4, were due to the local earth on the

Fig. 4.

shore end being within the range of the stray currents from the tramway rails. Consequently many "earths" were sought beyond this supposed sphere of action, by running landlines, "such as a telephone line to the top of Signal Hill, a telegraph line ending at an earth plate in the near Sea Point, an earth at the Observatory 3½ miles from Cape Town, an earth at Durban Road some 12 miles from Cape Town," &c., without finding any reduction in the disturbances. In fact, the ordinary earth of the shore end gave better results than any of these landline earths. As these various earths had failed, more definite experiments were tried at night, when it was found that the amplitude of the kicks, shown on the recorder slip, were in proportion to the distance of the experimental car from the power station (but greater when on the Cape Town side), and that the direction of the "kick" was reversed whenever the said car passed from the one to the other side of the power house. I may here remark, that the current required to pass through the coil of Lord Kelvin's siphon recorder, in order to give well-defined receiving signals, is only about from $\frac{1}{50}$th to $\frac{1}{30}$th of a milliampere; and consequently, the current delivered from the tramway power station to any one section of the tramway lines is often 10 million times as great that which creates the disturbances indicated by fig. 4.

(To be continued.)

ON THE PROTECTION OF ELECTRIC POWER TRANSMISSIONS FROM LIGHTNING.*

By J. T. MORRIS

(*Concluded from page 202.*)

Earth Connections.

Turning now to the subject of earths and earth connections for lightning arresters, it is obvious that it is of little use to have a reliable lightning arrester unless it is properly installed.

The earth must be an effective one, and the lead from the arrester to the earth plate as direct as possible.

The plans employed for making "earths" or "grounds," as they are sometimes called, differ widely.

In some cases where the soil is permanently damp the wire, after being brought down the post from the arrester, is formed into a loose coil 1 to 2 feet in diameter, and of several turns, and then buried in the ground.

A good plan to adopt, though more expensive, is some arrangement such as is shown in fig. 29. A hole is made in the ground about 4

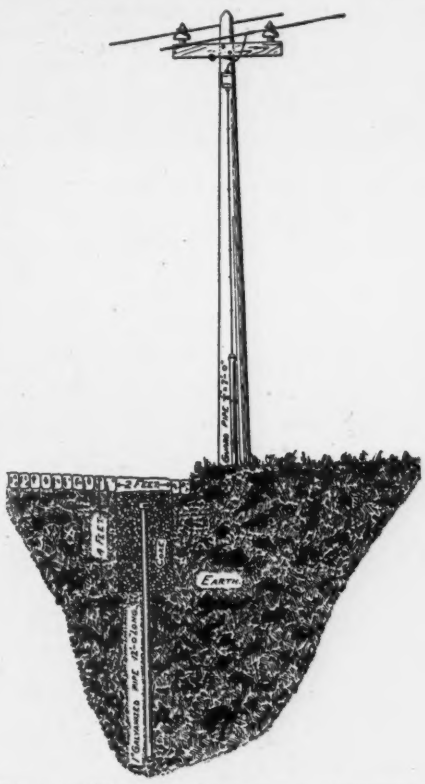
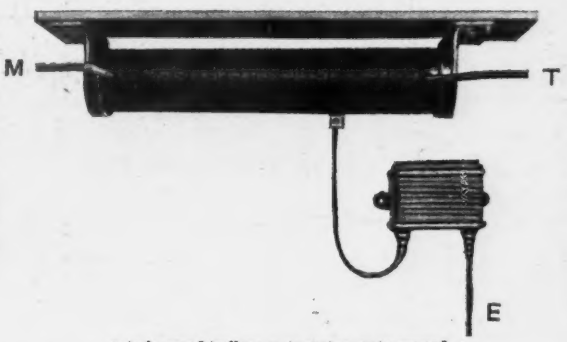


Fig. 29.—Method of Grounding an Arrester.

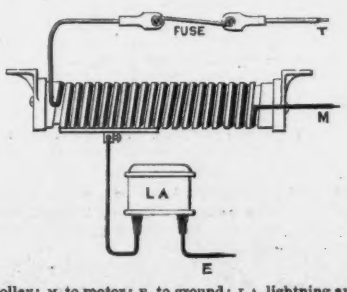
feet deep and 2 feet across. Then a galvanised iron pipe, 1 inch in diameter, and from 8 to 12 feet long, is driven into the ground, so



T, to fuse and trolley; M, to motor; E, to ground.

Fig. 30.—Choke Coil and Lightning Arrester for Tramcar.

that the upper part of the pipe, 3 feet in length, projects up into the 4-foot deep hole. The end of the wire from the line arrester, after



to trolley; M, to motor; E, to ground; L A, lightning arrester.

Fig. 31.—Diagram of Connections.

passing down the pole carrying the line wire, is soldered to a brass cap, screwed on to the end of the pipe. The hole is then filled with

* Paper read at a students' meeting of the Institution of Civil Engineers, February, 1898. Awarded a "Miller" prize.

crushed coke, well beaten down, leaving half a foot at the surface, and finally this space is filled in with earth.

Many other arrangements, however, are in use; the plan adopted in any given case is largely influenced by the surrounding conditions.

For example, if the power station be in a large town, then it is customary to make use of the water supply mains, as a good earth for the station arrester. In cases in which the power house is situate on the bank of a river, a good ground is often secured by burying a large copper plate in the bed of the stream; the copper wire from the arrester being riveted to the plates.

Instances have been brought to notice, through lightning arresters failing to act, in which line arresters have been earthed on iron poles set in Portland cement, or by simply pushing the earth wires into the ground; or of earthing a whole bank of station arresters on to an iron bolt driven into dry ground. But such examples as these are becoming less frequent, now that the principles of protection from lightning are better understood.

As mentioned above, the lead from the arrester to earth must be as short and direct as possible, sharp bends should be avoided, and the lead must on no account be formed into a coil. In some electric power transmissions installed some four or five years ago it is instructive to note that when putting in arresters for the protection of generators odd lengths of wire were not uncommonly used for making connections from the arresters to earth, and if they happened to be a little too long, a neat coil was made of the excess, so as to avoid cutting the piece. In this way the resistance to the passage of a sudden discharge from the arrester to earth was enormously increased.

The impeding effect of a coil of wire such as this to an extremely rapidly varying current is so great that coils are often actually used to prevent lightning discharges and other dangerous rapidly changing currents from flowing through them, and yet at the same time freely allow the passage of the ordinary power current along the line.

Such coils are known either as "choke" coils or "reactance" coils, and examples are shown more or less clearly in figs. 2 and 3, 13, 16 and 30—35. The term "reactance" is used owing to the manner in which such a coil reacts on a rapidly travelling electric wave in the line. The coil acts as a kind of reflector, and, at the same time, partial transmitter to a very limited extent of electric disturbances of excessively rapid variations, much in the same way as a very thin film of silver reflects a part and transmits the remainder of a beam of light falling vertically on to it.

For lines along which the power is transmitted with continuous currents—for example, electric traction systems—such coils as are shown in figs. 2 and 3 and 30 and 31 are not infrequently used. The plan adopted is to connect an arrester just before each choke coil, and so give the dangerous discharge an easier path through the arrester to

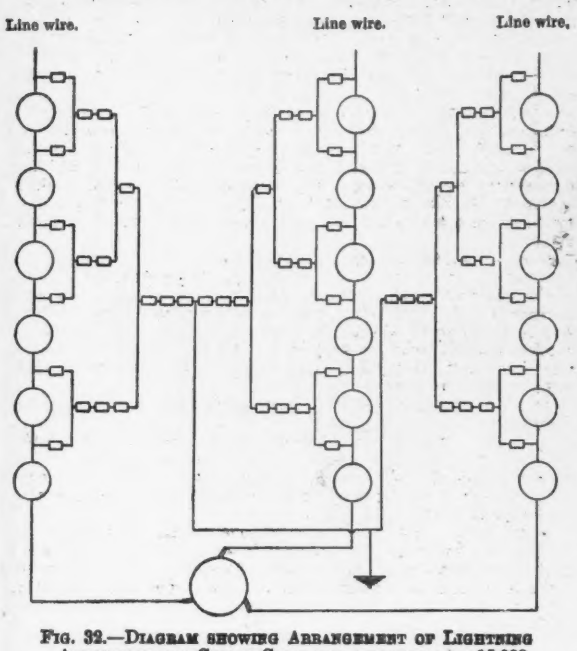


FIG. 32.—DIAGRAM SHOWING ARRANGEMENT OF LIGHTNING ARRESTERS AND CHOKE COILS FOR ONE END OF A 15,000-VOLT THREE-PHASE CIRCUIT.

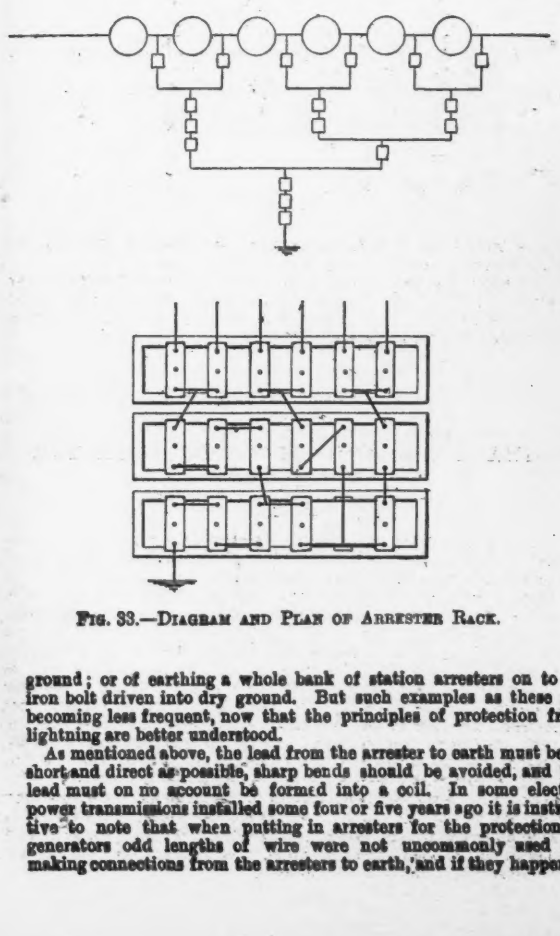


FIG. 33.—DIAGRAM AND PLAN OF ARRESTER RACK.

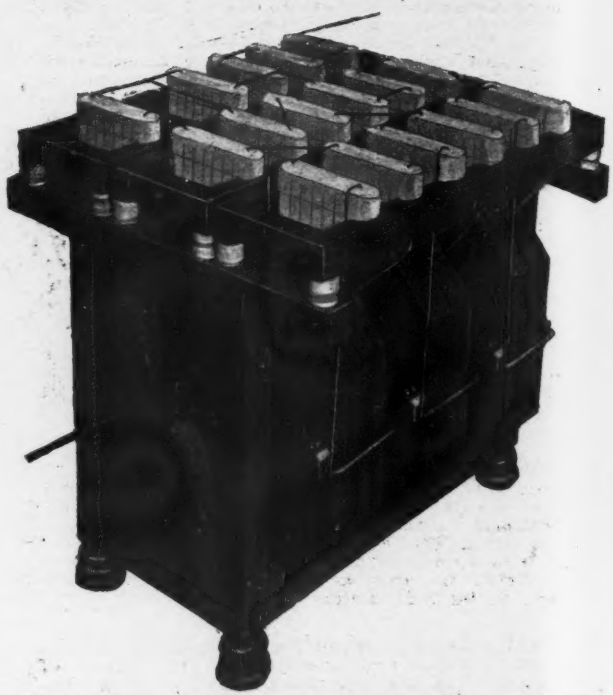


FIG. 34.—15,000-VOLT LIGHTNING ARRESTER AND CHOKE COIL RACK.

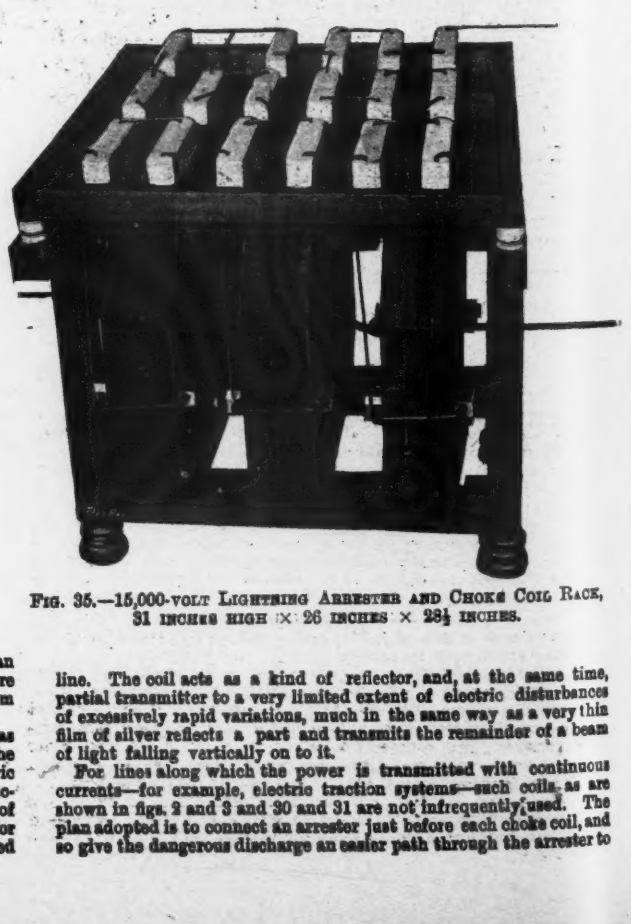


FIG. 35.—15,000-VOLT LIGHTNING ARRESTER AND CHOKE COIL RACK, 31 INCHES HIGH × 26 INCHES × 28½ INCHES.

earth than it would have by forcing its way through the choke coil, and so on by the line to the station.

In figs. 30 and 31 an example is shown of the application of choke coils to the protection of tramcar motors. A spiral groove is cut upon a long wooden drum, and bare copper wire is wound in the groove. Then a bare copper strip is fixed beside the drum (at the end connected to the trolley) for about one-third of its length, leaving a short space between each turn and the strip. This is connected to an arrester whose other pole is grounded. When in action any sudden discharge will rather leap across the numerous air gaps between the turns and the strip, and so through the arrester to earth, than follow round all the turns of the choke coil and afterwards go on to break down the insulation of the motor.

|| The General Electric Company, of America, form their choke coils, or reactance coils, as they term them, in a very simple manner. 150 feet of the line wire is wound into a coil, the inside diameter of which is not less than 15 inches.

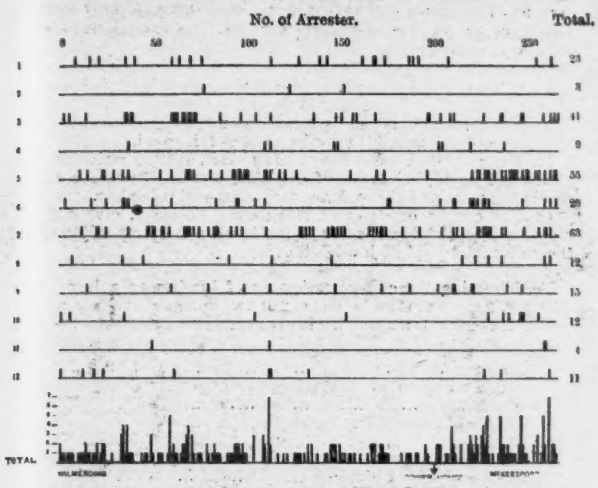


Fig. 37.—Record of Discharges during Twelve Thunderstorms.

In connection with this matter, the results of experiments by Mr. Wurts to determine the necessary number of arresters per mile of track will probably not be out of place.

The line selected for the experiments is known as the McKeesport and Wilmerding railway (see fig. 36), situate about 14 miles from Pittsburg, and operated by continuous currents at a pressure of 500 volts.

The track was equipped from one end to the other with lightning arresters every 100 feet; as it is 4¼ miles in length, about 270 arresters in all were erected.

The arresters used were the same as those shown in figs. 4 and 5, with this slight modification, that a very short air gap was inserted in series with each arrester, and in each of these air gaps an extremely thin piece of paper was placed. In the event of a discharge taking place across the arrester the paper was perforated, and then, by the examination of these papers, when removed after each thunderstorm, it was found which arresters had operated during any one thunderstorm, and a rough idea was obtained of the magnitude of the discharge from the size of the hole.

In fig. 37 some of the results of these experiments are shown in graphical form. Observations were taken for 12 thunderstorms. The fact that a discharge passed at any given arrester is indicated by the vertical lines on the number corresponding to that arrester; and the observations corresponding to any one thunderstorm are all marked against the thunderstorm of that number. On the lowest line the total number of discharges over each arrester during the 12 storms is given.

Storms Nos. 1 and 2 were of average violence.

Storm No. 3 was exceptionally heavy, and the controller of a car was damaged as it was running down-hill without power, opposite arrester No. 63. From the chart it will be seen that a very violent discharge occurred about this place. During the succeeding storms no accidents of any kind happened on this line. Throughout this time most other lines in the neighbourhood were either shut down or partially disabled.

The largest number of arresters receiving discharges during one thunderstorm was 63.

During the whole period over which the observations extended 163 out of the total of 272 arresters received discharges. Hence, 109 of the arresters remained inactive. A large number of the remaining 163 could have been dispensed with, and yet the line would probably have been efficiently protected.

It will be seen that two arresters received discharges during seven storms, five during five, five during four, ten during three, and so on.

At the present time, from the results of the working of a number of lines, it has been demonstrated that one arrester per mile in sheltered places, up to some 12 or so for more exposed portions of tracks, ensures a reasonable degree of safety.

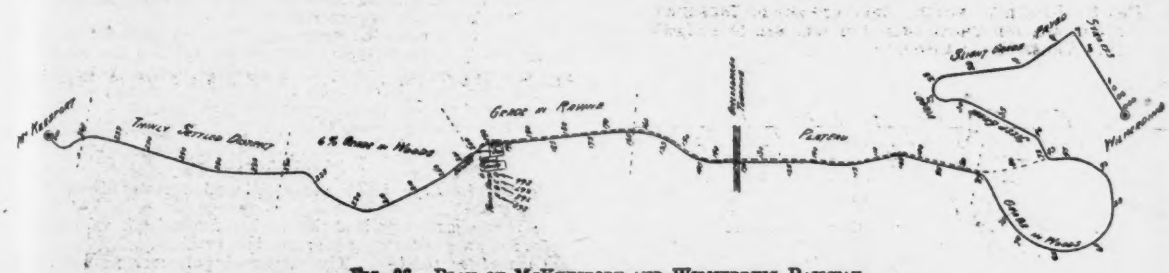


Fig. 36.—Plan of McKeesport and Wilmerding Railway.

The distribution of lightning arresters along lines for electric traction and lighting is a point which will be again referred to. But here it may be remarked that for the protection of power transmission circuits, *i.e.*, those where the power is generated at one end of the line and transmitted to the other end without a part of it being used at intermediate points, it is only necessary to place apparatus for protection of the circuit at both ends of each wire.

By way of illustration, the arrangement used by the Westinghouse Company for the protection of a 15,000-volt three-phase system has been taken (see figs. 32—35.) In fig. 32 a diagram of connections is given for the protection of one end of the three-phase circuit. Choke coils are represented by circles and arresters exactly like those shown in figs. 25 and 26 are indicated by small rectangles. On examination it will be found that seven arresters are in series between any part of each line and the earth; further, that between any pair of lines there are 14 in series.

As each unit arrester contains six air gaps, each $\frac{1}{32}$ inch, the above arrangement means that there are 42 air gaps, each one $\frac{1}{32}$ inch, between the line and earth. Fig. 33 gives a plan of the lightning arrester rack, and the connections which give this result for one wire of the system; while in figs. 34 and 35 two views are shown of the 15,000-volt circuit lightning arrester and choke-coil rack. The six choke coils can be seen in them, arranged in pairs beneath the arresters. These racks are about 2 feet 6 inches high.

Returning, in conclusion, to the subject of the positions and distribution of arresters. For electric power transmissions, as mentioned above, it is necessary to have lightning arresters and choke coils at the ends of the transmission alone, and these arresters and choke coils are now in a few instances located in a separate lightning arrester house, whose position is determined rather by the place where a good "earth" can be obtained, than by proximity to the power house.

For electric traction and overhead lighting circuits, the case is different; for in electric traction circuits, protection has not only to be provided for the plant in the power house, but also for all parts of the line.

The author desires to express his obligation for the facilities that have been afforded him in obtaining part of the information contained in this paper. To the Westinghouse and British Thomson-Houston Companies his thanks are especially due.

THE L.C.C. AND ELECTRIC LIGHTING LOANS.

The members of the Islington Vestry have determined, for the present at least, to defy the London County Council on the question of electric lighting loans, since after a brief explanation by Mr. R. Gordon, chairman of the Electric Lighting Committee, the Vestry decided at the meeting on Friday to decline the provisional sanctions offered by the Council of £10,000 on account of £13,200 and of £38,000 on account of £56,261 applied for by the Vestry for electric lighting works. The question was discussed in these columns on the 9th inst., and the report of the Electric Lighting Committee presented to the authority last week dealt exhaustively with the matter. The Committee, in giving a summary of the correspondence with the County Council, expressed the opinion that partly for the reasons mentioned in a separate report by Mr. A. Gay, the electrical engineer, and partly because it was undesirable to burden the undertaking with repayment and interest unless there was a certainty that the completion of the work would not be delayed for lack of the necessary capital, the provisional sanctions of the County Council should be refused; and, as already mentioned, the Vestry have endorsed the views of the Committee.

What the County Council will do in regard to the matter remains to be seen. It also remains to be seen what Islington will do in the present dilemma—unless the Vestry raise loans and leave the County Council to quarrel about sanctions subsequently. This policy is not a new feature of provincial authorities when dealing with the Local Government Board. In the meantime, the report of Mr. Gay, giving the result of his investigations of the letters from the County Council, is of interest as putting the whole question in a nutshell. The report is substantially as follows:—

I may say at the outset that every statement made in the Council's letters respecting lengths of cable and cost of material is incorrect. I cannot understand how the Council's officials could have made such serious mistakes. In the schedule attached to the letter of January 29th the first statement is to the effect that the 19/14 cable as shown by the specification is 39 per cent. in excess of that required. Even taking the actual length of frontage this should be at least 9½ miles instead of 9 miles as stated in the Council's letter. They have evidently also overlooked the fact that in some cases there are two cables or more in the conduits, as is clearly set forth in the specification. They have also apparently lost sight of the fact that in order to get to Hornsey Road and St. Paul's Road we have to lay cables from the works to the ends of these roads. If, therefore, we take the length of frontage as 9½ miles, and add to this the cables to connect the districts with the works, the length will be roughly 11 miles. If we further add 1½ miles for connections, slack in boxes, joints, &c. (approximately 13 per cent. not 39 per cent. as stated in the Council's letter) we arrive at a total length of 12½ miles. My estimate is therefore correct.

The other statement, that "in another description of cable," the length measured on the plans is 13 miles, while 20½ have been asked for—a difference of 58 per cent.—is also incorrect. The bare length of frontage under consideration is over 13 miles, but the actual cable required to light this district owing to the necessity for connecting with the works and various return loops from the parish boundaries is about 18 miles. To this has been added 2½ miles for connections to lamps, slack, &c., which is a little less than 14 per cent., or considerably less than has been previously agreed to by the Council. Again, I can only assume that this error has arisen through the misunderstanding of the specification, and of the system to be adopted.

With respect to the cost of connecting the arc lamps averaging £15 each, this includes in many cases a special surface box costing over £7; the actual length of conduit, instead of being 12 feet, averages 15 feet; and my estimate includes the whole of the cable-jointing, the pipes from the mains to the column, digging the trench, cartage of superfluous earth, re-instatement and re-lay, cartage of columns to the site, and loading and unloading the same. It will therefore be seen that the estimate instead of being high, is really low.

The Council also state that the prices for mains and conduits and street work combined are very high, unless there are special circumstances to account for it. In reply to this, I can only repeat what I have already informed them, that my estimate is based upon past experience with work in this parish. I again state most emphatically that the sum asked for is in no way excessive, and it would be interesting to know upon what assumption the Council's officials base their statement. There is not to my knowledge in London any similar system of cables and conduits. Considerable care has been taken in the working out of this system with a view to avoiding serious breakdown on the cables and mains, and providing facilities for rapid repair in the event of accident. I can only assume, therefore, that the Council are comparing the system at Islington with that of some other parish, and if this is the case, I say there *can* be no comparison. No two systems of mains can properly be compared—unless they are identical. Full descriptions of the system have been from time to time given to the Council, and they should therefore know that our system of mains, on account of the extreme precautions taken, would be more expensive than that of some other systems.

With respect to the offer of the Council to sanction a portion of the sums asked for, the Committee will remember that the Vestry some time since passed a resolution that no money was to be spent for any material until the sanction of the Council to the borrowing of the necessary funds had been received. In face of this resolution, I fail to see how the Vestry can accept a portion only of the amount required to carry out certain work. The Council make no specific statement as to which item or items in the application is, or are, in their opinion excessive and as far as the sum of £13,200 is concerned, the quotations received show that the Council's statement that the estimate is excessive, is incorrect. If the sanction to a portion only of the amount required is accepted, I should like to know how the money is to be spent. If the Council had objected to the sum of £4,000 for condensing plant, for example, and had granted £9,200 only, the matter would be very simple, as we could delay the erection of the condenser until the matter was settled. The balance, however, of £3,200 means nothing at all, and I do not see how it is possible to erect a portion of a steam pipe, or a portion of a pump.

I may say that this continual delay in the granting of sums of money, the estimates for which are perfectly fair and reasonable, is rendering the proper carrying out of the business most difficult. These loans were applied for six months ago, prices are rising almost every day, and the result will be, I am afraid, that by the time the Council have sanctioned the sums of £18,400 and £56,261 respectively, the amounts will be altogether inadequate to meet the rising market. As an illustration of this, although a slight provision was made for a possible rise in the market in case of cable, a considerable rise over and above that provision has taken place in the last three months. If the Council had asked for specific information within a short time after the application had been made, the whole of these points could have been readily cleared up, but it is not possible to give satisfactory replies to general criticisms made many months after the estimates have been prepared and sent to the Council.

In conclusion, permit me to say that if instead of making general statements, which have been proved to be incorrect, the Council would supply forms requiring more definite information in the first place, or if the Council's officials, when unable to interpret the specification, would ask me direct for explanations, there would be less loss of time in putting the matter right, notwithstanding which I consider the specifications and plans sent are sufficiently clear and intelligible to anyone with a knowledge of the business.

THE RESISTANCE OF DYNAMO BRUSHES.

MESSRS. R. B. TIBBATS, L. Lowenberg, and W. G. Burns, students of Columbia University, U.S.A., have recently carried out a series of interesting experiments with copper leaf, copper gauze, carbon, and graphite brushes on dynamos of 35 and 200 KW. capacity.

The dynamo upon which the first series of tests were made was an Edison upright 35 KW. machine, belt driven, and having a commutator with 48 segments. It was found that nothing less than 2 lbs. per square inch could be used advantageously on the carbon brush, as otherwise the voltmeter varied so much as to make it impossible to obtain accurate readings. This was also true of the graphite brush, but not to so marked a degree. From the tests made the following conclusions are drawn:—

1. The resistance of all brushes varies inversely as the current.

2. The resistance remains nearly constant for increase of pressure except at low currents.

3. The drop of all the brushes remains almost constant with increase of current (increasing slightly).

4. The tangential pull of all the brushes increases with the pressure.

5. The tangential pull of copper leaf and copper gauze generally increases with the current, but not invariably.

6. The tangential pull of carbon and graphite decreases with increase of current. In the case of carbon, this is especially true at one-half and three-fourths speed. With graphite the pull increases with increasing current at three-fourths speed.

7. The tangential pull is decreased considerably when the commutator is oiled. In the case of carbon and graphite at low pressures, the friction is slightly increased.

8. For copper brushes at one-half speed the tangential pull or friction is considerably increased; at three-fourths speed only very slightly increased. For both these speeds the resistance is the same, except for low currents.

9. On a cast-iron pulley the resistance of a copper brush is considerably reduced, while the friction is about the same.

10. For copper gauze and carbon the results at one-half and three-fourths speed are practically the same as at full speed.

11. For graphite brushes the pull is greater, and the resistance less at one-half speed, but at three-fourths speed the pull again becomes nearly the same as full speed, the resistance still being less.

12. The copper brushes run much more smoothly, give a much steadier drop, and do not spark as much when properly adjusted as the carbon and graphite brushes do.

To determine the contact resistance of brushes on a large commutator, tests were made on a 200 KW. dynamo running at 100 revolutions per minute, and having the following dimensions:—

Diameter of commutator	2 feet 8 inches.
Length " "	1 " 9 "
Peripheral speed of commutator feet per minute	846
Number of commutator segments	268
Width " " "	1/32 inches.
" centre to centre of mica	3/32 "
Number of sets of brushes	8
" of brushes per set	8

Current was led into the machine by one set of brushes, passed through the coils of the armature, to the top commutator bar, thence out through the testing brush. To prevent any drop of voltage due to current in the coils, the voltmeter brush had to be placed on the same commutator bar as the testing brush.

It was found possible to use much smaller pressures with the carbon and graphite than in the former tests without causing sparking. With the commutator dry this was the case with as low a pressure as 0·3 lb. per square inch for graphite, and 1·3 lb. for carbon, but with the commutator oiled the former pressure for graphite caused sparking, with large currents.

Cylinder oil is not to be recommended, as it is too thick, resulting in lines of scum on the commutator, which increases the resistance, and can only be removed by a vigorous application of sandpaper. On the other hand, machine oil is a positive advantage, as it leaves no scum, and reduces the resistance of copper brushes.

The following conclusions are drawn from these second tests:—

TANGENTIAL PULL.

Commutator Dry.—**1. The tangential pull increases directly with the pressure.**

2. The tangential pulls of the brushes, decreasing in value in this order: Copper leaf, copper gauze, carbon, graphite.

Commutator Oiled.—**1. The tangential pull increases with the pressure, but not in direct proportion.**

2. Between the limits of 2 lbs. and 7 lbs. per square inch pressure and no current, the tangential pull of copper gauze is slightly greater than that of copper leaf; between 3½ lbs. and 15 lbs. and no current, the pull of graphite exceeds that of carbon; between 2½ lbs. and 8½ lbs. the pull of copper gauze and leaf exceeds that of carbon or graphite.

3. The tangential pull of carbon and copper gauze decreases with increase of current.

4. Oil increases the tangential pull with no current.

RESISTANCE.

Commutator Dry.—**1. The resistance varies inversely as the current. The variation is very large with small currents, but small with large currents, approaching a constant resistance as a limit.**

2. The resistance varies directly with the pressure. The variation is very large with small pressures up to a certain critical point, beyond which it is very small.

3. The effect of pressure on the variation of resistance is greatest with small currents. With increase of current the critical point becomes more defined and corresponds to a smaller pressure, while increase of pressure beyond this point has less and less effect, till finally with increase of pressure or current the resistance is but slightly affected.

4. With copper gauze brush there is no well defined critical point.

5. The resistance of carbon is slightly less than that of graphite.

6. The resistance of copper leaf with very small currents is about the same as that of copper gauze, but with very large currents it exceeds that of the latter.

7. The resistance of carbon and graphite brushes greatly exceeds that of copper.

Commutator Oiled.—**1. Cylinder oil increases the resistance of graphite brushes, especially at small currents; with carbon at very small currents the resistance is increased, but with large currents it is nearly the same.**

2. Machine oil reduces the resistance of copper-leaf brushes at small pressures, and greatly reduces that of copper gauze.

In conclusion, the authors made comparative tests of the effect of large and small commutators when run at a peripheral speed of about 850 feet per minute, and they arrive at the following results:—

Comparison of Large and Small Commutators.

Commutator Dry.—1. The tangential pull of graphite and copper leaf is much less with large than with small commutators; with no current, that of copper gauze is slightly less up to 6 lbs. per square inch pressure, beyond which it is greater; that of carbon is less up to 13 lbs., beyond which it is the same.

2. With small commutators the tangential pulls decrease in the following order:—Copper leaf, graphite, carbon, copper gauze (no current).

3. With large commutators, the pull with carbon and graphite remains practically constant with increase of current, whereas with small commutators it decreases.

Commutator Oiled.—1. With large commutators oil generally increases the pull, while with small commutators (speed 1,580 feet), in the case of copper it decreases, except at very small pressures.

2. With small commutators (speed 1,580 feet) machine oil greatly reduces the resistance of copper gauze and leaf—in the case of the latter, especially with small currents; the reduction with large currents being greater with copper gauze. Machine oil reduces the resistance of carbon and graphite, except with small currents. With graphite the reduction becomes less marked with increase of pressure.

3. With small commutators (speed 1,580 feet) the tangential pull of graphite and copper gauze slightly decreases with increase of current.

Commutator Dry.—1. Graphite: With small commutators and small currents the contact resistance is greater than with large commutators, but with large currents becomes nearly the same.

2. Carbon: With large commutators and small currents, the resistance is greater than with small commutators, but with large currents it is only slightly greater.

3. Copper Leaf: With 1·4 lb. per square inch pressure, the resistance for all currents is nearly the same with either commutator; but with greater pressures it continually decreases with large commutators, whereas it remains nearly constant with small commutators.

4. Copper Gauze: For 1·5 lb. pressure and 75 amperes per square inch, the resistance with small commutators is but slightly greater than that with large commutators; but with small currents the resistance with small commutators becomes much greater.

COMPULSORY WORKS.

In common with other public bodies who obtain Parliamentary powers for the execution of their works, electric lighting companies have certain duties, of a more or less onerous nature, to fulfil towards the public. Among these duties perhaps the most important is the provision of a sufficient number of electric mains for the purpose of supplying current to such as require, and are willing to pay, a reasonable price for the same.

The rules and regulations with regard to compulsory works are to be found in Sections 21—26 of the Schedule to the Electric Lighting Clauses Act, 1899.

Section 21 (1) provides that the undertakers (*i.e.*, the electric lighting company) shall, within two years after the commencement of the special order, lay down suitable mains throughout every street, or part of a street, specified in the special order, and shall maintain such mains.

This provision is founded upon Section 19 of the Electric Lighting Act, 1882 (45 and 46 V. c. 56), which entitles everyone within a given area to demand electricity from the company.

Undertakers may also be required, by Section 21 (2), at any time after the expiration of 18 months from the special order to lay mains in other streets not specified therein. Such mains must be laid within six months after a requisition in that behalf has been served upon the undertakers.

As to the rights of persons to make such a requisition (*see* Section 24, *infra*).

If the street is repairable by the local authority, the consent of the Board of Trade need not be obtained, but it is provided by Section 21, ss. (3) that where undertakers are required to break up a street not repairable by the local authority, application must in accordance with Section 13 of the Electric Lighting Act, 1882 (45 and 46 Vict., c. 56) be made to the Board of Trade for their consent.

Rule 12 of the rules made by the Board of Trade (1890) provides that "Where the undertakers under any licence, order, or special Act, desire the written consent of the Board of Trade under Section 13 of the Electric Lighting Act, 1882, to enable them to break up any street not repairable by a local authority, or any railway or tramway which they are not empowered to break up under such license, order, or special Act, application for such consent must be made by memorial, and the memorial must specially request such consent, and must describe accurately the street, railway, or tramway which they propose to acquire power to break up."

Section 22 provides (in effect) that where the undertakers (not being the local authority) are about to lay wires in any street for the benefit of any particular person, they shall give a 28 days' notice to all other persons in that street who might possibly be willing to take a supply. Any two or more persons may then make an application for a supply, upon which the undertakers must lay the necessary mains.

The principle upon which this section is founded has already been referred to. See note to Section 21 (1) *supra*. It is important to observe that the notice must set forth the effect of the section.

Section 23 contains provisions as to the penalties, &c., imposed upon undertakers who fail to lay down mains. Again a distinction is observed between the local authority acting as undertakers and other undertakers. In the case of ordinary undertakers failure to furnish mains involves a daily penalty not exceeding £5, while wilful and unreasonable delay may involve revocation of the order as to the whole or any part of the area of supply. If the local authority are undertakers, their failure to furnish mains may involve revocation of the special order as to the whole or part of the area, subject to such conditions as may seem fit to the Board of Trade.

The periods within which the mains are to be laid are (1) in the case of streets mentioned in the special order, two years from the date of that order; (2) in the case of other streets in which the laying of mains has been specially requisitioned, six months after the requisition has been served.

Provisions with regard to the revocation of special orders are contained in Section 63 of the schedule to the Act of 1899.

Section 24 (1) provides that a requisition to lay down mains for general supply in any street shall be made by six or more owners or occupiers, or by the local authority having charge of the public lamps therein. Such requisition (of which a form can be obtained from the undertakers) must be signed by the owners, occupiers, or the local authority as the case may be, and served upon the undertakers.

It is important to notice that whereas only *two* or more signatures are required for the purpose of procuring the laying of mains under Section 22 *supra*, *six* or more are required, in order to secure the laying down of mains for the purpose of general supply.

Section 25 (1) relieves the undertakers from the burden of providing and laying down mains, unless they are provided with a satisfactory guarantee that the supply taken during the first three years shall produce annually a reasonable sum. Such sum must not exceed 20 per cent. of the aggregate cost of laying the additional mains, unless it is otherwise decreed by the Board of Trade.

It is important to observe that the period mentioned in this section is three years, whereas in the case of a supply from the street main to a private consumer the period is only two years (*see* Section 27 of this Act).

Section 25 (2) provides that no requisition shall be binding on the undertakers unless within 14 days thereof they receive the necessary guarantee or security for the payment of all moneys which may become due during the first three days.

Section 25 (3) provides that if the undertakers are of opinion that the requisition served upon them is unreasonable, an appeal may be made to the Board of Trade who may—

(1) Say the requisition is unreasonable, or

(2) Authorise the undertakers to demand security for a longer period than three years.

(3) Specify such sum or percentage as may seem just.

All differences between the undertakers and persons signing the requisition are to be settled by arbitration.

Section 26 provides that any local authority demanding a supply for public lamps may be compelled to execute an agreement binding them to take a supply for three years.

MODERN MACHINE SHOP ECONOMIES.

Mr. Oberlin Smith, who writes a historical summary of machine tool practice in *Cassier's Magazine*, is an authority in America, and has probably broader views on machine tool construction than many American writers, who are too much inclined to accord praise to an American tool simply because it is American, and in doing this are going further than any Englishman who esteems things English above all others. In one particular item Americans have distinguished themselves in their self-laudatory method. This is the lathe leg. The American lathe leg is a double-curved spindly affair, totally unfit to act as the support for anything that requires a concrete foundation. Yet this lathe leg is put to such uses. It is put in its very worst form even to support the treadle-worked lathe of the amateur, and a very nice little American amateur's lathe was recently shown us by its owner, who, while praising many of the details of the lathe, had only contempt for the miserable legs and the equally inefficient slide rest. In these two items, and in the faulty ∧ bed Americans persist along erroneous lines as stupidly as the most ultra-conservative English manufacturer.

Fifty years ago, writes Mr. Smith, many lathes had only a power feed on the carriage, but none on the cross slide—we presume he is referring to American practice—and feeding was done with a rough endless chain, but sometimes by the chaser screw—a fault, by the way, of long survival. Mr. Smith condemns the small spindles in lathes. This is a point of weakness in American machines. He condemns light lathe beds as unfit to check vibration, and has a word to say in favour of the apparent clumsiness of English box frames.

The early machine tools were cast with architectural features, and a machine frame has even been copied from a grape vine arbour, grapes and all. We don't think this was ever done in England, but we do know that to-day, in London, there are pumps sold chiefly, we admit, for country house work, in which the frame is a sort of aborted Gothic design, and so designated. Most of the modern American tools, however, have put away all semblance of such fan-

tastic ideas, and generally are of good design, always excepting the silly lathe leg, which is sometimes claimed as good, because it spreads the base of the machine. But surely four straight legs would do the same, and would have a plain and mechanical appearance.

We must say that the English lathe, with its hardened spindle, good slide rest, flat bed and sure support, is substantially a far better working tool. It might be improved by the addition of some of the natty details of the American machine, but in its broad features it is far ahead. It is not, indeed, so much in standard machine tools that Americans have excelled. It is in the automatic tools, those machines, useless except for their one particular duty, that they have scored well. This Mr. Smith illustrates by citing the rough castings for mowing machines, in which all holes are bored, and, where wanted, tapped, simultaneously in a special multiple drilling machine. Such machine sides are thus rapidly produced within tolerable limits of accuracy, practically interchangeable, and, of course, cheaply saleable.

Mr. Smith rings the changes in a curiously ambiguous manner between the advantages of the system he eulogises, with its cheap and unskilled labour, and, three paragraphs ahead, clean, attractive, intelligent labour, and again, "a contented, yet ambitious *personnel*," and having used one French word where its use was permissible, he proceeds to use, quite unnecessarily, another one, to wit, *materiel*, that would have given better sense in plain English. We fear that in writing magazine articles some writers aim so much at effect as to give impressions which have an air of unreality.

At the moment the very considerable influx of American products has given a perhaps undue prominence to American systems of manufacture. That these are good no one will deny, but it is open to doubt whether the very fault in ourselves that has laid us open to so much American criticism is not fully as much a feature of American manufacturers. Several complaints have lately reached us of the scornful manner in which the slightest hint is received as to possible improvements. These are flatly refused, on the, perhaps, very good grounds that would-be customers may "take it or leave it" if they don't like it, and we believe that the end has not always been "take it." Adherence to standards is good to a point, but the methods of American grandfathers are no more likely to lead their grandsons to fortunes than has been the case on this side. As with ourselves, a certain class of faults becomes stereotyped, and nothing will persuade an American he is wrong. The lathe leg is one of these; the slide rest and miserable tool posts are others. Both are perpetuated by tender materials, and a careful survey of American successes seems to show that they have done well in brass working machines, for there is no difference in texture of brass as there is in cast iron. But where our naturally harsher materials have had to be tackled, the success is less marked and, apart from tools, other American productions are chiefly successful when the quality of durability is of less moment than some other quality.

We believe the neat and convenient details of many American productions may well be imitated by our own makers, and that a combination effect, avoiding vices and embodying virtues in a well thought out manner, will ultimately characterise the production of both countries. Where, for example, can be procured reasonably accurate tools like squares, callipers, and the like to compare with American productions? No one here makes a speciality of these articles, for which there must be a ready sale at a good profit at half the prices charged for them. Then, how many are seriously tackling the question of overhead electrical equipment in this country in the provision of the gun-metal ears, insulators, and trolley wire hangers now being used in thousands? There is an enormous field for capital investment at this moment practically unoccupied and ready to be filled by anyone who will manufacture overhead equipment, to name one class of work alone, on American shop methods.

ELECTROSTATIC MEASURING INSTRUMENTS.

We recently published a letter from Mr. G. L. Addenbrooke calling the attention of our readers to an idiostatic electrometer designed by him, which gives very satisfactory results. As a matter of fact, the design of electrometers lends itself much more completely to calculation, and the behaviour of any given pattern can be much more accurately predicted than is the case with any of the ordinary direct-current instruments, such as galvanometers, voltmeters, &c., and no great advance is to be expected in existing forms, except in the convenience of the mechanical arrangements, or by some entirely new departure. The rules for the best proportions to be given to such instruments were worked out very completely some years ago at the Central Technical College in Exhibition Road, and the well-known Ayrton-Mather instruments were the outcome of the investigation. We do not suppose that the limit of sensibility has been reached either with the Ayrton-Mather or the Addenbrooke instruments. Indeed, it is clear that Lord Kelvin's multicellular pattern or the Ayrton-Mather instrument could be constructed for laboratory purposes of greater sensitiveness than the present were required, while the general proportions and design of the Addenbrooke instrument are not the best possible from the point of view of sensitiveness.

As to the present degree of sensitiveness of such instruments, we have seen a fairly aperiodic Ayrton-Mather instrument which gave an angular displacement of 7° with 4 volts, so that ·1 volt would produce an angular displacement of about one-fourth of a minute, an easily observable quantity. This potential difference is mentioned by Mr. Addenbrooke as being possible to detect with his instruments, so that the two seem to be of about the same order of sensitiveness. Such a test is, of course, a very imperfect mode of comparison, as the distance between the plates, the oscillation period of the movable system, the resistance of the suspension, are equally important quantities in comparing two designs, but as sensitiveness seems to be a principal object with Mr. Addenbrooke the comparison may be made.

The idiostatic electrometer is rapidly establishing itself as the only satisfactory instrument for alternating voltages, and if the mechanical difficulties due to the small value of the forces can be surmounted, soft iron and hot wire instruments should disappear. Mr. Addenbrooke's instrument is not intended, apparently, for anything but laboratory work, and does not at first sight appear to be an exceptional instrument of its class.

We wish someone would write a small book on electrometers. The electrical problems connected with them are too complicated, perhaps, for anything but approximate treatment in a popular work, but the mechanical problems are simple and attractive. Some account of Lord Kelvin's earlier work, and of the absolute and quadrant electrometers, is found in all text-books, but there must be many points of interest connected with the later multicellular instruments which are not commonly known. The large quantity of information existing at the Central Technical College on small irregularities due to the springs in the absolute electrometer, and the methods of avoiding them, is only partly published, and we imagine that Prof. Barton, of Nottingham, might have much to say on his idiostatic instruments used in the measurement of the propagation of electrical waves along wires.

Mr. Addenbrooke's application of his electrometer to measuring the alternating voltage of a telephone circuit is curious, since the instrument appears to be unsuited to the purpose. The charge conveyed to a moving vane or needle through a suspension strip is so greatly affected by the resistance of the strip and the frequency of the alternations, that the indications of the instrument must be difficult to interpret. For example, a needle whose capacity is 10^{-13} (Mr. Addenbrooke's figure) charged through a strip whose resistance is 10^{10} (10 ohms) with a frequency of 800 a second (about the frequency of the third upper partial of the male speaking voice), is charged only to one-fiftieth of the impressed voltage. With such a frequency as 800, the inductance of the strip (which may be 100 to 1,000 units) would not materially affect the point, but with a frequency of 8,000 the inductance will also begin to tell. In the instrument used by Prof. Barton the vane is not charged through the strip, and this source of error is avoided. The frequencies, moreover, are so large, that such an instrument as Mr. Addenbrooke's would probably give no indication at all, though it might be equally sensitive with Prof. Barton's to steady potential differences. Probably Mr. Addenbrooke's strip has not such a high resistance as 10 ohms, while the telephone currents would have components of a frequency of about 200, so that a deflection is to be expected. The instrument, however, might clearly be very misleading if used for such work.

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS' DINNER.

The last annual dinner of the Northern Society of Electrical Engineers, as such, was held on Friday evening last at the Grand Hotel, Manchester, the President, Mr. S. Z. de Ferranti, occupying the chair. About 55 gentlemen were present, among whom were Prof. S. P. Thompson, Dr. Nicolson, Messrs. Browett, Clirehugh, Cowan, Marr,

Raworth, Taylor, and Wordingham (members of the Council), and Mr. S. Joyce, hon. secretary.

After an excellent dinner, accompanied by selections rendered by a guitar and mandoline quartette, the loyal toasts were duly honoured, and the President expressed regret at the absence of Mr. Alex. Siemens and Prof. Perry, quoting a humorous letter of apology written by the latter.

Prof. THOMPSON toasted the Society and its President, remarking that he had known Mr. Ferranti 20 years, and he did not seem a year older! The Professor complimented the Society on its own youth and vigour and on the excellent papers which had been read before it. The election of Sir Michael Foster and Mr. Mather to Parliament was of favourable import to the electrical industry, in view of the comprehensive schemes of power distribution now on foot. Expressing a hope that Mr. Ferranti, who is about to take up residence in London, would rejoin the Council of the Institution of Electrical Engineers, Prof. Thompson concluded with the statement that he was "a jolly good fellow"—a sentiment which the company promptly set to music.

In his reply, the PRESIDENT said that the keynote which Prof. Thompson had struck was that of PROGRESS, which was exemplified by the amalgamation of the Society with the greater Institution. The decision to take this step was practically unanimous. The power of the Institution must be made equal to that of the Civil Engineers, and we must be aggressive in pushing forward its interests, which are our own; there was no doubt that electricity was the thing of the future!

Mr. HENRY EDMUNDS, in proposing "The Profession," dwelt on the advantages of social intercourse, in removing trade jealousies and disseminating the fruits of experience. The toast was coupled with the name of Mr. Hammond, who represented all sides of the profession, and was accorded choral honours.

Mr. HAMMOND, in his reply, referred to his Sunday-school days, whereat the audience was much delighted. But the speaker was in solemn vein, and dwelt on the awe-inspiring nature of the mysterious agency which electricians control, exhorting the members to do their duty if they wished well to the industry.

Mr. RAWORTH, in proposing "The Visitors," congratulated the profession on the state of business, expressing the opinion that American competition was now over for some years to come.

Prof. THOMPSON, whose name was coupled with the toast, promised on behalf of the Council of the Institution to cultivate the interests of the members, and stated that the following papers would shortly be read:—

"Electro-Therapeutics," by Dr. H. Lewis Jones, of St. Bartholomew's Hospital.

"Electrical Equipment of Men-of-War," by C. E. Grove, of the Thames Iron Works.

"Long Distance Transmission of Power," by Prof. Geo. Forbes; and "Dynamo Construction," by W. M. Mordey.

It was also announced that arrangements are being made to hold a joint meeting of English and American electrical engineers at the Paris Exposition.

Dr. HOPKINSON, President-elect of the new "Manchester Branch" of the Institution of Electrical Engineers, proposed "Technical Education," introducing Dr. Nicolson, who has returned from the University of Montreal to take charge of the engineering department of the Manchester Technical Institute.

Dr. NICOLSON, in reply, said that we in England were behind the times in traction, telephony, the heating of houses, and technical education. As regards the first, the American types of "traction engine," judged by English standards, were of the most crude description, and it was absurd to suppose that English engineers could not beat them. After referring to our inefficient telephone systems and our barbarous methods of warming houses, Dr. Nicolson stated that technical education here usually consisted of teaching elementary mechanics to school boys, and 90 per cent. of the products were useless in competition with foreign nations. *The men must be got when they were older*, even after they had attained to positions of responsibility. Heads of firms must be brought to realise the importance of affording facilities to their staffs to conduct experiments and researches in properly fitted laboratories; the brief description which followed of the proposed equipment of the Manchester laboratories left no doubt as to the importance of the work for which they are intended; all who wish to carry out technical investigations will be welcomed to perform them at the Institute.

The proceedings were then terminated by the National Anthem.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1900.

Compiled expressly for this journal by W. P. THOMPSON & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

2,231. "Telephone ear instrument holder." A. H. STAMP. Dated February 5th.

2,260. "Improvements in electric arc lamps." H. BAERMER. Dated February 5th. (Complete.)

2,271. "Improvements in or relating to electric ignition devices for explosion engines." A. J. BOULT. (La Societe Anonyme des Moteurs et Voitures "Aigle," France). Dated February 5th. (Complete.)

2,282. "Improvements in dynamo-electric machines." G. DALEN and A. HULTQVIST. Dated February 5th. (Complete.) (Date applied for under Patents, &c., Act, 1883, Section 103, July 7th, 1890, being date of application in Sweden.)

2,297. "Method of transforming alternating into direct currents and *vice versâ*." D. COOK. Dated February 6th.

2,310. "Improvements in the application of electric lamps to dentists and like mirrors." J. H. MURRAY. Dated February 6th.

2,340. "Improvements in telephones." E. DUCRETET. Dated February 6th. (Complete.)

2,356. "Improvements in apparatus for regulating the electric lights on theatre stages." SIEMENS BROS. & Co., LIMITED. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated February 6th. (Complete.)

2,357. "Improved electro-magnetic bell signalling apparatus." SIEMENS BROS. & Co., LTD. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated February 6th. (Complete.)

2,366. "Improvements in the production of filaments for electric incandescence lamps." A. ROUBLEFF. Dated February 6th.

2,370. "Improvements in means for maintaining a constant speed of a driven shaft, electric generator, spark generator, or other revoluble part." G. C. DYMOND. (H. N. Motsinger, United States.) Dated February 6th. (Complete.)

2,384. "Improvements in or relating to alternate current distribution." W. M. MORDEY. Dated February 6th.

2,407. "A combination trolley pole catcher and rope holder." S. C. CASHEL. Dated February 7th.

2,409. "Improvements in electrodes or electrical conductors." H. A. KENT. Dated February 7th.

2,473. "Improvements relating to electric arc lamps." E. C. MARCAY. Dated February 7th.

2,518. "Apparatus for recording without friction the indications of electrical and other measuring and indicating devices." A. ECKSTEIN and H. J. COATES. Dated February 8th.

2,526. "Improvements relating to incandescent electric lamps." W. J. MARTIN and M. LACHMAN. Dated February 8th.

2,543. "Improvements in and connected with primary batteries." S. W. MAQUAY. Dated February 8th.

2,544. "Improved means of making electrical connections to carbon electrodes." H. BAKER. Dated February 8th.

2,549. "Improvements in contacts for electrical alarm bells." J. KUNST. Dated February 8th.

2,590. "Improvements in conduits for gas, air, water and like pipes, and electric wires." R. D. KIMBALL and A. A. MCKENZIE. Dated February 9th.

2,595. "Improvements in electrical, storage or secondary batteries." A. W. BAXTER and C. BAXTER. Dated February 9th.

2,612. "Improvements in railway light signalling apparatus for use in foggy weather." SIEMENS BROS. & Co., LIMITED. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated February 9th. (Complete.)

2,621. "A new or improved safety device for electric lamps." A. RUHSTRAT and E. RUHSTRAT. Dated February 9th. (Complete.)

2,629. "Improvements relating to pocket magnetic compasses." R. HADDAN. (J. E. Whiting, India.) Dated February 9th.

2,638. "Improvements in Röntgen ray apparatus and in interrupters applicable for use in connection therewith or for other purposes." J. M. DAVIDSON. Dated February 9th.

2,639. "Improvements in and relating to telephonic apparatus." G. BLANCK, S. SYMONS and A. P. B. LOFTUS. Dated February 9th.

2,641. "Improvements in electric traction on the road contact system." J. J. STEINBACH. Dated February 9th.

2,662. "Improvements in brush holders for dynamo-electric machinery." THE LANCASHIRE DYNAMO AND MOTOR COMPANY, LIMITED, A. P. WOOD and R. S. MCLEOD. Dated February 10th.

2,670. "Improvements in the production of vacuum bulbs for electric incandescent lamps." G. T. HUTCHINSON and H. K. PACKARD. Dated February 10th.

2,684. "A non-sparking (or sparkless) current collector for electric tramcars or other electric motors where bare supported mains are used." N. ROBINSON. Dated February 10th.

2,691. "Improvements in electric cables." H. EDMUNDS. Dated February 10th.

2,700. "Improved method of and means for indicating speed or current frequency of electric generators." R. D. MERSHON. Dated February 10th. (Date applied for under Patents, &c., Act, 1883, Section 103, July 12th, 1899, being date of application in United States.) (Complete.)

2,702. "Improved electro-magnetic brake dynamo and meter." E. H. RIETER. Dated February 10th.

2,703. "Process and apparatus for electrolytically impregnating textile fabrics of all kinds by means of metallic salts." A. DE CASTRO and H. W. SCHLOMANN. Dated February 10th. (Complete.)

2,710. "Improvements in electricity meters." W. M. MORDEY and G. C. FRICKER. Dated February 10th.

2,712. "Improvements in telegraphic apparatus." J. A. DEARLOVE and S. G. BROWN. Dated February 10th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

20,502. "Improvements in and connected with surface contact railway systems and in apparatus for use therewith." The British Thomson-Houston Company, Limited. (H. B. Potter.) Dated September 7th, 1897. Electric railways and tramways on a road contact system with electro-magnetic switches. Relates to means for reversing the car, for maintaining the circuit when the motors are cut out, and for changing the connection of the battery which operates the road switches. Permanent way: Conductors, switches.—The vehicle is reversed by the arrangement of line. The road contacts are omitted on the straight portion, and are made broader on the curves to ensure contact with the collectors. A turntable may be used instead with the road contacts thereon. To maintain the circuit on the vehicle, a pair of extra contacts are placed on the driver's switch, so that the battery can supply current to keep the road switch thrown. A switch reverses the connection of the battery putting it into connection with the return studs instead of the supply studs. This is done by a tappet on the rails, which acts through a bell-crank and pawl on the vehicle to throw over the switch arm. 8 claims.

20,521. "Improvements in electric signalling apparatus and circuits." E. H. Owen, C. N. Williams, and F. H. Donaldson. Dated September 7th, 1897. Relates to electric signalling apparatus for communicating between a central station and a number of separate stations, such as the principal room, &c., of a hotel, school, steamship, store, &c., and the private rooms, class rooms, &c. The arrangement of contacts in circuit, &c., are shown in diagrams too complicated for purposes of abridgment. 5 claims.

20,591. "Improvements in electric tramway and electric transmission of power systems." C. W. G. Little. Dated September 7th, 1897. In those systems of electric tramways or electric transmission of power, in which the drop of poten-

tial in the return circuit is controlled by a "booster," an automatic regulating appliance for the booster is used. A conductor between the points to be regulated contains an electro-magnet switch, which connects a source of power to a motor, and this motor regulates a resistance in the field circuit of the booster. 2 claims.

20,666. "Improvements in dynamo-electric machines and motors." S. G. Brown. Dated September 8th, 1897. Sparking, preventing, field magnets. To prevent sparking at the commutator, due to distortion of the magnetic field by armature reaction, the field magnet is constructed in two magnetically distinct parts arranged one within the other, and excited by coils wound round each pair of adjacent limbs. The extremities of the part are expanded into pole pieces which are wider than the poles of the inner part. In machines liable to great variations in the load an additional pole is provided between the limbs of the inner part of the field magnet. 15 claims.

20,732. "Improvements in or relating to electric signalling apparatus for railways." G. F. Gascoyne. Dated September 9th, 1897. Relates to instruments placed on engines and in signal cabins and connected by suitable means. A disc is secured on a spindle which carries a polarised armature moved in one direction or the other by the currents through the coils. Coloured segments or other signals on the disc can thus be exposed behind openings in the casing. The motion of the disc is limited by the shoulder coming against the stop, and the disc is held in either extreme position by a detent operated by the magnet and released when the current is interrupted. The current can therefore be broken and re-made to operate the repeating disc any number of times without altering the main signal. A contact breaker is provided to enable the signalman or engine driver to operate the disc as required. In the upper part of the casing there may be fitted a second disc for indicating whether sidings or branches are open. The disc has a white segment, which may be exhibited behind either of two openings in the case, and is covered when in the normal position. When a current is sent through the magnet the disc is moved in one direction or the other, and when the current is broken a permanent magnet restores the disc to the normal position. The movement of the disc is limited by stops striking the arm. This arm is raised each time a current is passed, so as to clear the central stop, but it cannot be moved clear of the other stops. 6 claims.

20,781. "Improvements in the generation and distribution of electricity by means of alternating currents and appliances connected therewith." L. B. Atkinson. Dated September 9th, 1897. Relates to alternating current systems. An induction motor arranged in the circuit is driven in some cases above synchronism to serve as the generator, the alternator being used only to impress the required number of periods. In other arrangements, the induction machine may be used only to supply the idle or lagging current. The induction machine may be arranged at the generating station or at a distance, and may be driven separately or by another induction motor, suitable gearing being used. The machine may be connected to the circuits directly or through transformers, and be used with single or polyphase currents. Regulation is effected by inserting suitable resistance or capacity, or varying the relative speeds or the relative number of poles to the machines. 8 claims.

20,834. "Improvements in arc lamps." J. D. F. Andrews. Dated September 10th, 1897. Relates to arc lamps with solenoids acting directly on the upper carbons. In one arrangement the upper carbon is attached to an iron core which slides in a tube closed at the top to check its motion. The tube is surrounded by a series solenoid. The tube may be of glass, with an arc-enclosing globe formed on it, and supporting the lower carbon. Or the tube may be of brass, attached air-tight to the globe. The globe may be exhausted or contain any gas. In a focussing lamp the iron core is connected by cords with rods which slide in guides and carry the arc enclosing cylinder and lower carbon, the core being the heavier. An inner cylinder, preferably of mica, lessens the deposit on the cylinder. The solenoid may be enclosed in iron, or wound on an iron tube. In modifications, a tube partly of iron may carry the upper carbon and move over a fixed solenoid; or the tube may be fixed, and the solenoid movable with the carbon. The iron cores or tubes may be thickened at one end and the movable parts may be counter-balanced by weights, or opposed springs. 4 claims.

20,845. "Improvements in accumulators or secondary batteries, and in means for transporting the same." A. Muller. Dated September 10th, 1897. Consists of a method of suspending cells in cases so that they may be carried on electrical tramcars or other vehicles. In one form each cell is formed at its upper end with outwardly bent projections which rest on insulated longitudinal carriers, which in turn rest upon supports fitted in the box or casing, and having cut-away parts serving as drip edges for any spilt acid, which flows to the sloping bottom of the casing and is carried away through the hole. The walls of the casing are covered with glass plates. Instead of resting directly upon the supports the cells may be of ordinary shape and have fitted around their bottom and sides U-shaped hooks, the projecting upper ends of which rest on the supports. In another modification, the supports are near the bottom of the casing and the bottom corners of the cells rest on them. In another modification, supports are arranged transversely to the casing so that several cells are supported in line across the casing as well as along it. The cells themselves are covered with projecting studs which keep them apart and away from the casing. The casing has a cover. 9 claims.

20,865. "Improvements in and relating to primary batteries for light motive power and like purposes." W. Decker and G. van Struve. Dated September 10th, 1897. Batteries are provided with means for supplying and discharging the electrolyte, and for raising and lowering the plates out of and into the electrolyte; consists of a casing divided into two parts by a longitudinal partition, and further sub-divided into separate cells by partitions. Apertures at the bottom of each cell communicate with a longitudinal groove in a revoluble plug. When it is desired to fill the cells, the cock is closed and the liquid is run from a vessel through the grooves and apertures into the cells. The plug is then turned through a half revolution, and the vessel may then be emptied through the port and cock. To empty the cells, the plug is turned to the former position and the cock is opened. Instead of a plug for each group of cells, one plug with two grooves may serve for both. In the modification, apertures are made at the bottom of the partitions, and in each aperture is fixed a soft rubber tube, in one end of which is fixed a hard rubber tube, on which is a collar connected by a rod to a common rod. By moving the rod, all the tubes can be turned down to lie horizontally in the cells, so that they are all placed in communication with each other and may be simultaneously filled or emptied. The plates are fixed to an insulating plate which is suspended by straps over a shaft and balanced by a counterweight. By operating a crank connected to the shaft the plates are raised or lowered as required, and their position may be indicated on a dial on the casing. 4 claims.

20,883. "Improvements in apparatus for working electric tramways by means of underground cables." C. Anderson. Dated September 11th, 1897. Relates to collectors for use with a system such as is described in Specification No. 14,647, A.D. 1893, in which road contacts are raised and lowered during the passage of the vehicle. The long collector is made substantially in two parts, each hung from the bogies and widened towards the centre so as to cover the road contacts when rounding curves. The parts bear on a fixed bar with rolling, sliding or other electric connection, and properly curved to allow for the swing. The ends are turned up to ride over the contacts and carry insulated ramp pieces which depress pegs when the vehicle passes. The collector is supported by springs in brackets attached in various parts of the under frame, and the collector bar is preferably made of channel section of steel, faced on its under-side with phosphor bronze. 8 claims.

21,623. "Improvements in electric connecting devices applicable to lampholders, wall plugs, and the like." C. L. R. E. Menges. Dated September 21st, 1897. Electric incandescent lampholders are constructed for bayonet-capped lamps. A socket is provided with curved slots to receive the pins of the lamp cap, and slides within a case and on a body which carries the case. The body carries rigid contact studs to bear against the contact plates on the lamp cap. The socket has extensions acted on by a spring which holds the lamp cap against the body. The case is shouldered, threaded, and provided with a nut to hold a shade; it may be dispensed with. Such lampholders may be provided with switches. In one arrangement a stepped insulating strip slides diametrically through the casing and body which are slotted to receive it between the two contact studs, so that, when the thicker part of the strip is pushed into the holder, the lamp is lifted out of contact with the studs. In another arrangement a rotatable insulating strip is interposed between the contact studs and lamp; it carries contact pieces, which connect the studs and lamp when it is turned to proper positions. Wall couplings are constructed similarly to the lampholders, with plugs similar to lamp caps. The body of the holder may be made with a flat base and carry strips, the socket being provided with lateral extensions to slide on these. Three-wire connections may be made by placing the socket and pins in one circuit, or by providing three contact studs. Fusible cut-outs may be constructed similarly. 5 claims.

21,669. "Improvements in insulators for telegraph and like wires." G. Ashby. Dated September 22nd, 1897. An insulator for telegraphic and other purposes consists of a glass or other disc held between shouldered wooden discs in the arms of a fork by a bolt. The fork is secured by a screw to the cross-arm or other object. A wire and a binding-wire are held in a groove in the insulator. One side of the fork is extended to form a temporary catch for the wire. When attached to a side wall the fork is replaced by a central screw bolt. 2 claims.

21,704. "Improvements in secondary electric batteries or accumulators." S. W. Hart. Dated September 22nd, 1897. The grid is formed with cells in rows facing alternately in opposite directions, and backed with a lattice arrangement. In casting the grid, parts project at right angles from the plate, and are subsequently turned down to form claws to aid in holding the active material in place. 3 claims.

21,814. "Improved device for deriving weak currents from main current conductors." M. Sichel. Dated September 23rd, 1897. Relates to switches for obtaining weak currents from main conductors. A resistance is arranged across the mains, and the conductors for the weak current are connected to intermediate points of the resistance, the resistance has intermediate points connected to a pair of contacts. Another pair of contacts are connected to the branch circuit, *e.g.*, a house telegraph. On operating the push the main circuit is first completed by the push contact, and then contact is made at the parts of contacts. 2 claims.

21,818. "Improvements in electric arc lamps." T. E. Adams. Dated September 23rd, 1897. Relates to a clutch lamp, which consists of a casing having hinged side portions and carrying a guide tube, rod and box, and a globe cover. The globe is provided with a top ring carrying a net, and is supported by a ring adjustably secured to the box by a clamping screw, a shoulder limiting the downward movement of the globe when the screw is slackened. An ash tray is hinged and locked to the ring. The upper carbon is carried by an arm of a crosshead provided with guide rollers, a box to contain weights, and a clutch blade. The crosshead is hung by a chain on a pulley, the other end of the chain carrying a rod and the lower a carbon-holder. This is loose, and the lower carbon is held against a fixed guide by a roll on pivoted links. The blade is engaged by a clutch connected by a heavy link with an arm of the armature of the regulating magnet. A yoke is connected with a link, and has an arm which may bear on a fixed stop. A pin in the yoke carries one jaw: the other jaw is supported by a part of the yoke, so that it is pressed against the blade when the linked end of the yoke is raised. The regulating magnet is a straight bar secured to the top of the casing, and provided with three pole-pieces. Series and shunt coils are connected so that the two end pole-pieces are magnetised alike, oppositely to the middle one. The middle one carries a knife-edge and side arms to engage a steel strip and another knife-edge on the armature; the armature is thus supported, and the edges are held together magnetically. The ends of the armature are near the pole-pieces. To compensate for temperature variations, the lower end of the armature is divided obliquely from the main portion, and is connected with the latter by a long brass strip. The lower end of this strip is pivoted to the piston rod of an air pot pivoted and spring supported on arms on the magnet. When not in action, the whole lamp is shunted by a small resistance, carried by the armature, which then makes a contact at the top of the lamp. This resistance is larger than that of the series coil and carbons, in order that the lamp may start when current is supplied. 24 claims.

21,836. "An improved appliance for facilitating reference to business names and addresses particularly for telephonic purposes." E. Howe. (J. D. Browning.) Dated September 23rd, 1897. An appliance for facilitating reference to business names and addresses, especially those of telephone subscribers, comprises a stand or wall bracket to which cards bearing the necessary information are secured by means of eyelets and strings, or laces. The bracket may be made of pasteboard or other suitable material, strengthened by metal bands, the ends of which serve as hooks for attaching the bracket to a wall; projections on the bands pass through the pasteboard, &c., and form stops. The sides of the bracket taper upwards to allow the front to be inclined. In another form of bracket, the back edge of every card is held within a folded strip of tin or other material, which is hinged to the bracket. Thin leaves, for additional information, may be secured to the bracket independently of the cards. The margins of the cards are utilised for indexing purposes. 4 claims.

21,851. "Improvements in and relating to electro-motors for driving centrifugal pumps." A. F. Spooner. (**Societe Emile Saimson et Cie.**) Dated September 23rd, 1897. Relates to motors for driving centrifugal pumps direct, the object being to keep the discharge of water the same when the lift varies. Included in the shunt circuit of the field magnet coils is a liquid resistance, the out-flow from which is unchecked, while the in-flow is controlled by a valve connected to the differential pistons. These are connected to two pipes, having tapered and funneled ends respectively, in the pump delivery, so that when the flow in the delivery is too small the valve closes, the water falls, increasing its resistance, and the speed of the motor therefore rises. Similarly, when the flow in the delivery is too great, the speed of the motor falls. In order to avoid shifting the brushes for these changes of speed, armature reaction is obviated by the action of coils in series with the armature wound in recesses in the pole-pieces. 4 claims.

21,951. "Improvements in and relating to electrical alarms." R. Hottmann. Dated September 24th, 1897. Relates to an electrical contact, applicable to windows, doors, drawers, &c., which is adapted to complete a circuit through an alarm bell when the window, &c., is opened. The wires from the bell circuit are connected to two plates fixed to one of the window sashes, these plates being disconnected, when the window, &c., is closed, by the other sash, &c., pressing back the spring pin which carries the bridging contact ring. When the window, &c., is opened the pin is released and the alarm circuit is closed by the ring making contact with the plates. 2 claims.

21,974. "Improvements in or relating to electric telephones." T. Sloper. Dated September 25th, 1897. Relates to improvements in the inventions described in Specifications No. 13,367, A.D. 1891, and No. 10,350, A.D. 1895. The telephone stations are provided with a number of lines corresponding to the number of instruments and a common return or signalling circuit. One line at each station is connected to the lever and the other lines are brought to a multiple point switch, the lever of which is connected to the Morse calling key. The battery is arranged in circuit with the microphone and primary of the induction coil, but also is shunted through the receiver when the communicating circuit is complete. Any number of pairs of subscribers can be connected simultaneously, as the common return wire is cut out on completing the communicating circuit. 2 claims.

22,022. "Manufacture of insulating material for electrical purposes." C. Beadle. Dated September 25th, 1897. Insulating compositions are formed by mixing with "viscose" bituminous matter, such as tar, pitch, or powdered bituminous coal, and evaporating the solvent. 1 claim.

22,032. "Improved detachable securing mechanism for electric incandescent lamp shades." P. P. Adolph. Dated September 25th, 1897. Relates to holders for incandescent lamps. Adapters, such as that shown in section, are used to support shades or reflectors. The shade or reflector is held between a screw or other metal socket and cap which are secured on an insulator by two bolts. These parts form one electric connection, and a central bolt is the other. The cap is placed in an ordinary lampholder, and a corresponding lamp in the socket. The construction permits damaged parts to be replaced. 2 claims.

"Electrical Review" List

HIGH PRES

PLACE.	Lighting Authority.	System of Distribution.	Boilers.	Engines or Turbines and H.P. of each unit.	Type of Generators.	Size of Generators.	System of Driving.
PROVINCIAL.							
(1) Aberystwyth ..	Aberystwyth & Chiswick E.S.Co.,Ld.	High pressure with house transformers	2 Economic	3 vert. com. (Browett-Lindley) 75 i.h.p. each, 1 of 53 i.h.p.	2 Johnson-Phillips and 2 Brush arc	2 50 kw., 2 55 arc lighters	Rope and belt
(2) Altrincham	Altrincham Elec. Supply Co., Ltd.	Transformers in houses	4 Lanc. ..	2 200 h.p., 2 100 h.p., 1 400 h.p. erecting (Browett-Lindley)	5 Edison-Swan	2 120 kw., 2 60 kw., 1 30 kw., 1 240 kw. erecting	Direct coupled and rop
(3) Ayr	Corporation	Transformer sub-stations	Lanc.	2 horiz. 175 h.p. (Marshall), 1 vert. 50 h.p., 2 vert. 25 h.p., and 2 350 h.p. (Belliss)	5 Siemens	2 200 kw., 2 100 kw., 1 25 kw.	Direct fly wheel a ternator
(4) Bath	Corporation	Sub-station and house transformers	4 water tube boilers	4 vert. (Brush) engines, 150 h.p., 2 (Pollitt & Wigzell) 500 h.p.	4 Mordey alternators and 2 300 kw. direct alternators, E.C.Co.	4 75 kw., 2 300 kw.	Rope and direct
(5) Bedford	Corporation	Sub-stations and 3 wire distributors	7 water tube boilers	Com. vert., 3 (Belliss) 55 h.p., 2 (Allen) 150 h.p., 1 (Allen) 260 h.p., 1 (Allen) 500 h.p.	3 Johnson-Phillips, 2 Siemens, 2 Easton-Anderson	3 30 kw., 2 90 kw., 1 150 kw., 1 250 kw.	Direct ..
(6) Blackpool	Corporation	Sub-station transformers	5 Galloway, 2 Fraser mar., 1 Babcock w. t.	1 400 h.p., 2 200 h.p., 2 100 h.p. (Fowler), 1 500 h.p. (Ferranti), 2 200 h.p., 1 100 h.p., 1 1,000 h.p. (Par. tur.)	Leeds and London, Ferranti, E.C.C., and Parsons	1 300 kw., 1 200 kw , 2 100 kw., 3 50 kw., 2 100 kw., 1 500 kw.	Rope and direct
(7) Bolton*	Corporation	Sub-stn. trns., accmltrs. for exciting pur.	6 Lanc. ..	Vert. com. 4 350 i.h.p., 2 200 i.h.p., 1 100 i.h.p.	Mordey and Ferranti	4 200 kw., 2 100 kw., 1 50 kw.	Ropes and direct
(8) Bournemouth ..	Bournemouth & Poole Elec. Sup. Co.,Ltd.	Sub-station transformers	Water tube (B. & W.)	9 (Brush) engines	Mordey	1 350 kw., 1 150 kw., 2 100 kw., 5 60 kw.	Ropes and direct
(9) Bray (Ireland) ..	Urban District Council	Sub-stations and house transformers	1 Davey-Paxman loco., 1 Lnc (Tinker)	1 120 i.h.p. (Brush), 1 120 (Robey), 1 130 (Easton - Anderson), 2 (Victor turbines)	Kapp and Easton-Anderson-Goolden	2 60 kw. (Kapp), 1 75 (E.A.G.)	Belts and direct
(10) Bristol*	Corporation	Transformer, sub-stations & 3 wire dist.	Lanc. and Babcock	Willans	Siemens and Ferranti	2 88 kw., 4 400 kw., 4 210 kw., 4 52 kw., 2 165 kw., 252 excit.	Direct ..
(11) Burton-on-Trent	Corporation	Street transformers	6 Lanc.....	3 horiz. com., 140 h.p. each, 1 horiz. comp., 300 h.p.	Lowrie-Hall	3 80 kw. each, 1 220 kw.	Rope and direct
(12) Cambridge	Cambridge Electric Supply Co.	Sub-stations, 3 wire distributors	4 Lanc.....	5 (Parsons) turbines	Parsons	1 35 kw., 1 60 kw., 3 100 k.w.	Direct ..
(13) Cardiff.....	Corporation	Transformer sub-stations	7	2 60 b.h p. comp., 2 270 b.h.p. trip., 1 500 i.h.p. comp., 1 500 i.h.p., 3 crank compound tandem	5 Siemens disc armature, and 1 Ferranti flywheel	2 40 kw., 2 180 kw., 2 300 kw.	Direct ..
(14) Carlow	Alexander's Electric Works	Cur. con. dir. by a rotary converter	Water tube boiler	Belliss engine 110 i.h.p., 2 turbines 60 h.p., 1 water wheel 30 h.p.	E.C.C. alternators at Milford	1 65 kw. alt., 1 50 kw. alt., 1 30 kw. dir. cur. dynamo	Belt ....
(15) Chagford	Chagford and Devon Elec. Light Co.	—	—	Water wheel driven by River Teign	——	—	Belt ....
(16) Chatham	Chatham, Rochester & District	Sub-chambers in streets	3 Babcock and Wilcox	2 (Marshall) 200 i.h.p., 1 (Marshall) 100 i.h p., 1 (Robey) 180 i.h.p. 1 Parsons turbine, 750 h.p.	2 Brush and 2 Ferranti alternators, 1 Parsons	2 125 kw., 1 100 kw., 1 50 kw., 1 500 kw.	Ropes, belt and direct
(17) Chelmsford† ..	Chelmsford Elec. Lighting Co.	Transformer sub-stations	2 Lanc., 1 water tube	2 (Willans) 140 h.p., 2 (Willans) 120 h.p., 1 (Peache) 40 i.h.p.	Crompton	2 80 kw., 2 70 kw., 1 20 kw.	Direct ..
(18) Cheltenham....	Corporation	Transformer sub-stations	3 Galloway, 4 Babcock	2 (Willans) 80 h.p., 1 (Willans) 180 h.p., 2 (Belliss) 180 h.p , 2 (Belliss) 360 h.p.	Siemens	1 33 kw., 3 110 kw. 2 220 kw.	Direct ..
(19) Coatbridge	Scottish House to House Electric Co.	Transformer sub-stations 2 wire	2 Lanc.....	3 vertical marine, 100 h.p. each	Mordey	3 50 kw.	Rope ..
(20) Coventry	Corporation	Street trans. boxes and sub-stations	Lanc.	3 horizon. com. 100 h.p., 200 h.p., and 400 h.p., 1 400 h.p. vertical	Fowler & Co., and Fynn	1 50 kw., 1 100 kw., 2 200 kw.	Rope and direct
(21) Croydon	Corporation	Transformer sub-stations	Davey-Pax., Babcock & Wilcox	Belliss engines, 3 200 i.h.p., 2 400 i.h.p., 1 800 i.h.p. being installed	British Thomson-Houston ..	3 120 kw., 2 250 kw., 1 500 kw. nearly complete	Direct ..
(22) Derby*	Corporation	Trans. substns., direct current for street ltg.	6 Lanc. ..	2 250 h.p. (Browett-Lindley), 2 100 h.p. do., 3 50 h.p. do , 3 30 h.p. do., 1 10 h.p. do., 1 1,000 h.p. (Ferranti)	Siemens disc alternators and arc machines, and Ferranti alternator	2 150 kw. alt., 3 60 kw. do., 2 28 kw. do , 3 18 kw. arcs, 1 600 k.w.	Direct ..
(23) Dover*	Dover Elecy. Supply Co.	Transformers in street bxs.	Water tube	Open type vertical, 84, 138, 2 175 i.h p., and 1 260 h.p.	Mordey, and G. E. dynamos for tramways	1 50 kw., 1 75 kw., 2 100 kw., and 1 150 kw.	Direct ..
(24) Dublin	Corporation	Sub-station transformers	4 water tube 2 marine	1 (Willans) 400 h p., 1 (Fowler) 400 h.p., 1 (Fowler) 100 h.p., 3 (Coates) 350 h.p., 3 (Brush) 60 h.p.	E. C. C., Fowler, British Thomson-Houston	2 200, 3 150, 1 50 and 3 Brush arc lighters	Direct and rope
(25) Ealing	Urban District Council	Sub-station transformers	4 Lanc , 2 erecting	Browett-Lindley, 895 h.p., 2 450 b.h.p. (Belliss) now being erected	Siemens	2 131 kw., 2 60 kw., 2 28 kw., 3 18 k.w., 2 10 kw., 2 300 kw.	Direct ..
(26) Eastbourne ..	Eastbourne Corporation	Street and house transformers	4 loco., 2 econ , 2 water tube	1 (Fow.) com. 250, 1 (Mar.) 200, 1 (Fow. un'type) 60, 1 do. 50, 1 (P'he.) 260, 1 (Wilians) 100, 1 (Willans) 350	E.C.C. and Fowler	2 40 kw., 2 70 kw., 1 30 kw., 1 150 kw., 1 100 kw., 1 50 kw., 1 250 kw.	Rope and direct
(27) Eccles	Corporation	H. T., 2,000 v.	Lanc.	2 200 h.p. vertical (Browett-Lindley)	Johnson & Phillips	2 120 kw., 1 25 kw. motor altrnatr. and accumulators	Direct coupled
(28) Exeter	Corporation	Sub-station transformers	Water tube, 1,200 h.p	2 com. hori. 150 h.p., 1 do. 80 h.p. 1 com. v. 200 h.p., 2 tri. ex. 25 h.p., 1 v. 200 h p., 1 v. com. 400 h.p.	Brush, Easton-Anderson, Thomson - Houston and Ferranti	2 75 kw., 1 50 kw., 2 100 kw., 2 30 arc lgt., 1 250 kw. alt.	Rope, belt and direct
(29) Fareham	Urban District Council	Sub-station and house transformers	2 loco., 1 econ.	1 com. horiz. 105 h.p., 1 vert. 75 h.p., 1 vert. 40 h.p., 1 95 i.h.p. (Peache)	Thomson-Houston, Johnson and Phillips	2 35 kw., 1 50 kw. alt., 2 30 light T.H. arc machines	Belts, ropes & direct
(30) Halifax*	Corporation	Sub-station transformers	4 Lanc., 2 water tube	1 horiz. 100 i h.p., 2 horiz. 200 i.h.p., 1 horiz. 600 i.h.p., 1 vert. 600 i.h.p.	E.C.C.	1 50 kw., 2 100 kw., 2 200 kw., 2 350 kw.	Rope and direct
(31) Hanley	Corporation	Sub-station transformers	6 Lanc	2 com. 100 i.h.p., 2 do. 200 i.h.p., 2 do. 25 i.h.p., 1 do. 500 i.h.p., 1 do. 1,000 i.h.p.	Mordey, Ferranti, and Brush arcs, 4 Ferranti 30-light rectifiers	2 50 kw., 2 100 kw., 2 arc 12 kw., 1 500 kw. & exci., 1 600 kw. & exci.	Rope and direct
(32) Harrogate	Corporation	Sub-station transformers	3 Lanc	2 250 h p., 1 50 h.p., 1 600 h p., and 1 600 h.p. (Ferranti), to be fixed shortly	Ferranti and Siemens	2 125 kw., 1 25 kw., 1 300 kw.	Direct
(33) Hastings	Hastings Corporation	Sub-stations and house transformers	6 water tube	3 200 h.p., 1 120 h.p. (Raworth), 1 200 h.p. (Belliss), 3 60 h.p. (Peache)	Mordey, and 3 35 kw. Crompton alternators	3 100 kw., 1 50 kw., 1 200 kw., 3 35 kw	Rope and direct
(34) Huddersfield ..	Corporation	Sub-station transformers	6 water tube 6 Lanc.	2 200 h.p , 1 450 h.p., 2 550 h.p. (Ferranti and Brush), 2 1,250 h.p. (M'Laren)	Mordey, Ferranti and Siemens	1 100 kw., 1 140 kw., 1 250 kw., 2 300 kw., 2 600 kw.	Rope and direct
(35) Keswick†	Keswick Elec. Light Co.	House transformers	Lanc.	Engine and turbine	Kapp	2 30 kw.	Belt ....
(36) Killarney	Electric Ltg. Co.	Sub-station transformers	—	1 engine 60 h.p., 1 turbine 50 h.p., 1 water wheel 100 h.p.	Mordey	1 60 kw., 2 25 kw. ..	Ropes ..
(37) Kingston-on-Thames	Corporation	Sub-station transformers	3 Lanc., 2 Babcock & Wilcox	(Belliss), 4 30 h.p., 1 40 h.p., 2 75 h.p., 1 150 h.p., 1 300 h.p.	Siemens	1 25 kw., 2 50 kw., 1 100 kw., 2 20 kw., 2 20 kw. excit., 1 200 kw.	Direct ..
(38) Larne.....	Larne Electric Lgt. Works, Ltd.	Transformer sub-stations	2 Lanc.....	2 horiz., 100 h.p.	Mordey	2 40 kw.	Rope ..
(39) Leeds.....	Corporation	Sub-stats. and house transformers	Lanc.	Fowler, Hick-Hargreaves, and Belliss, 3 200 h.p., 3 400 h.p., 5 500 h.p., 1 1,000 h.p.	E.C.C., Fowler, and Ferranti	3 100 kw., rope drvn., 3 200 kw. do., 5 300 kw. dir., 1 640 kw. dir.	Rope and direct
(40) Leicester	Corporation	Sub-station transformers	6 Babcock and Wilcox	4 horiz. (Hick, Hargreaves), 600 h.p. each	Ganz inductor alternators ..	4 400 kw.	Direct
(41) Lynton and Lynmouth	Electric Ltg. Co.	Sub-station transformers	1 loco.	Giant turbines, 150 h.p. (Pelton wheels), 100 h.p., 1 engine, 40 h.p.	Mordey and Lowrie Hall....	2 38½ kw., 1 70 kw.	Direct and belt
(42) Monmouth	Town Council	Sub-station transformers	2 Cornish..	2 (Ransomes) com. vert. engines 35 h.p., 2 (Gilkes) "mixed flow" turbines (abt 60 n.h.p., 8ft. head)	2 Siemens	2 21 kw. each.....	Belt ....
(43) Morley (Yorks)	Corporation	Sub-station transformers	2 Lanc. ..	2 (Pollitt & Wigzell) 200 h.p., 1 (Peache) 70 h.p.	E.C.C.	2 125 kw. alternators, 1 20 kw. alternator, 1 35 kw. exciter	Flywheel, direct
(44) Newcastle-on-Tyne	Newcastle and Dis. Electric Lighting Co.	House transformers	Lanc.	Parsons turbines	Parsons turbo-alternators ..	75 to 500 kw.	Direct ..
(45) Newcastle-on-Tyne	Newcastle Electric Ltg. Co.	Sub-stats. and house transformers	Lanc.	Robey horizontal, 2 500 h.p.	Mordey	1,370 kw.....	Rope ..
(46) Newport	Corporation	Street and house transformers	7 Lanc. ..	4 com. 150 h.p., 1 com. 120 h.p., 2 500 h.p. horiz., 1 200 h.p. vert.	Fowler and Hall.....	4 75 kw., 1 50 kw., 2 300 kw., 1 100 kw.	Ropes and direct
(47) Paisley	Town Council	Sub-station transformers, 3 wire dist.	6 Babcock and Wilcox	1 (Adamson) hor. com. 1,000 i.h.p., 1 (Ferranti) vert. com. 175 i.h.p.,	Ferranti ironclad	1 600 kw., 2 200 kw., 1 100 kw.,	Direct ..

List of Electricity Works of the Un

RESSURE ALTERNATING CURRENT

f Generators.	System of Driving.	Condensing or Non-condensing.	System of Mains.	Number of Arcs and Incandescents used in Private Lighting.	Number of Lamps used in Street Lighting; Arc and Incandescent.	Number of 8 C.P. Lamps added during past 12 months.	Price Charged to Private Consumers.	System of Charging.	Type of Meters Employed on Consumers' Premises.	Present actual Capacity of Works in kw.	Nature of Fuel used.	Total Cost of Construct-ing and Equipping Works.	Cost of Mains.	Annual Revenue per 8 C.P. Lamp.	Number of High Voltage Lamps used.	Periodicity
v., 2 55 arc s	Rope and belt	Non-condensing	B.I.W.and Fowler-Waring lead cov. and arm'rd conc.	11 arcs and equivlts. of 2,500 8 c.p.	29 arcs....	1,200....	6d.	Meter ..	Chamberlain-Hookham	—	Anthracite and coke	—	—	—	200	100
w., 2 60 kw., w., 1 240 kw. g	Direct coupled and rope	Condensing....	H.T. concen. feeders and H.T. concentric distribtrs.	25,000 8 c.p.	—	7,000....	6d.	—	Shallenb'r, Chamb-'lain-Hookham and Thomson-Houston	360 kw., & 240 kw. etg.	Household screenings and burgie	£22,872	£9,125	—	—	80
v., 2 100 kw., v.	Direct fly-wheel alternators	Either	Callender's concentric	14,500 8 c.p.	90 arcs, 75 16 c.p. incandescent	4,923 in 6 months	6d. first hour, 4d. afterwards	Brighton	Thomson-Houston and Chamberlain-Hookham	625 kw.	Dross	£45,000	£9,500	6/7	About 1,500 200 v., remainder changing	60
, 2 300 kw.	Rope and direct	Condensing....	Callender's solid system	Equivalt. of 18,546 8 c.p. lamps	88 arcs, 13 50 c.p. incandescent	2,556....	6d. & 4½d. for lighting, 3d. for power	Discounts to large consumers	Shallenb'r, Chamb-'lain-Hookham and Thomson-Houston	900 kw.	Coal	—	—	—	None	100
., 2 90 kw., w., 1 250 kw.	Direct ..	Surface condensers	Rubber cables in iron pipes or conduits	26,000 8 c p.	527 lamp cols. with 2 incan. in each	8,000....	5d., less ½d. within 1 month	—	Chamb'lain-Hookham and Shallenberger	670 kw.	Hard steam coal and scrnd. peas	£28,500	£35,000	—	None	60
., 1 200 kw , w., 3 50 kw., w., 1 500 kw.	Rope and direct	Condensing....	Paper cbls. laid in troughs	60,200 8 c.p.	191 arcs ..	—	7d. first hour, 2d. after, churches, 5d., motors, 2½d.	Brighton	Shallenb'r, Thomson-Houston and Aron meters	1,550 kw.	Bituminous coal and coke	With extensions £162,500	£32,000	6/1	With one or two exceptions 200 v. used throughout	83
., 2 100 kw., v.	Ropes and direct	Both. Klein cooler	Rub. concen. fdrs., jute arm'rd distrs., B.I.W. for both.	56,000	5 arcs	10,000 ..	6d. first hr., 3d. af., or 5d. all rnd. 10 % dis.	Brighton, &c.	Westinghouse, Thom.-Houston, and Ferranti	1,050 kw.	Slack, 10/4 and 12/–	£72,000	£25,000	5/–	Intend changing over	83
., 1 150 kw., w., 5 60 kw.	Ropes and direct	Condens. Klein cool. Körting spray coolers	Arm'rd con. in grd., unarm'rd con. in pipes and conduits	44,000 8 c.p.	None	11,000 ..	7d. and 8½d.	Brighton	Thomson-Houston and Aron	1,000 kw.	Coke and small coal	—	—	6/10	About 5,000 ..	100
v. (Kapp), A.G.)	Belts and direct	Condensing, one engine	Lead cov. con. laid in grd., B.I.W.	4,889.....	30 arcs and 171 incn. of 25 & 32 c.p.	864	6d. and 8½d.	Meter ..	Shallenberger and Chamberlain-Hookham	195 kw.	Welsh steam coal and slack	£8,510		—	None	60
, 4 400 kw., w., 4 52 kw., v., 252 excit.	Direct ..	Surface condensing	Arm'rd lead concen in grnd.; distbrs., tri. con.; also six con. for arc cir.	82,580	312 arcs ..	16,576 ..	Lighting, max. 5d., min. 2½d.; power 1½d., min. 1½d.	By meter and automatic clock	Thomson-Houston Shallenbrgr. and Aron	3,154 kw.	Coal, Welsh washed pea nut	£222,944, including mains, &c.	£80,853	7/10	—	93
each, 1 220	Rope and direct	Eject. condens., 1 machine jet condenser	H.T. feeders, con lead cov. paper in c.i. pipes.	10,970 8 c.p.	—	1,250....	6d. and 3d., power, 2½d.	Brighton system	Shallenb'r, Chamb-'lain-Hookham, and Thomson-Houston	660 kw.	Slack, coke, refuse from gas works	£30,000		4/9	None	75
, 1 60 kw., w.	Direct ..	Condensing, jet and surface	H.T. feeders, rub. cables in pipes, B.I.W. triple con. distributors	3 arcs, 27,909 8 c.p.	1 arc.....	2,829....	7d. and 3½d. for ltg. & power, 3½d. for street ltg.	Hopkinson's max. demand	Shallenb'r & Thom. Houston, with Barker & Ewing's max dem. attacht.	395 kw.	Slack	£59,184		5/6½	20. Is to be eventually adopted	90
2 180 kw., w.	Direct ..	Condensing....	Silvertown concentric, B.I.W. and Siemens	22,000 8 c.p.	63 arcs, 35 glow lamps	4,888....	6d. 1 hr., 3d. af., 2½d. pr. & htg., & 2d. 4000 p.an.	Brighton for lghtg. purposes	Thomson-Houston, Shallenberger, and Aron	1,040 kw.	Washed pea nut and nut coal	£71,018		6/11	5,000.....	40
lt., 1 50 kw. 30 kw. dir. amo	Belt	Non-condensing	Ovhd. to Carlow, lead cov. cbls. in Doulton con.	1,052 incandescents	13 arcs and 54 16 c.p.	140	7½d., with discounts	Meter ..	Thomson-Houston	145 kw.	Welsh coal	—	—	—	—	—
—	Belt	—	Paper cables	—	16 32 c.p. incandsnt.	—	10/– per 8 c.p. per annum	—	—	—	—	—	—	—	None	—
, 1 100 kw., ., 1 500 kw.	Ropes, belt and direct	Condensing....	Brooks, Glover's con.	9,400, equiv. 8 c.p.	—	3,050	5d.	Meter ..	Shallenberger, B. T. H., and Aron	900 kw.	Welsh coal and small	—	—	—	None	100
2 70 kw.,	Direct ..	—	Rub. cbls. H.T. in Doult'n cndts. L.T. in iron pipes	2 arcs 5,250 8 c.p.	21 arcs, 240 30 c.p. incandes'nt	1,200....	6½d. with ½d. discount for cash	—	Mainly Thomson-Houston	320 kw.	Hard steam and Welsh	—	—	7/8	None	—
3 110 kw. v.	Direct ..	Condensing....	Armoured and unarmoured	22,700 8 c.p.	197 arcs, 18 incandsnts.	—	6d. to 3⅜d., 3d. for power and heat	Brighton, approx.	Mainly Thomson-Houston	800 kw.	Small coal	£39,700, st. lmps., £8,300	£37,700	—	Extensions entirely on 200 volts	93
.....	Rope ..	Independent condenser	H.T. con. & sngl. vul. rub., in c.i. pipes L.T. Callndr's C.C.	—	8 arcs	—	7d. for first hour, and 3½d. after	Brighton	Thomson-Houston	150 kw.	Washed single nuts	—	—	—	None	100
1 100 kw., v.	Rope and direct	Condensing....	L.T. armoured concentric	16,600	40 arcs	6,600....	6d. and 3d.	Brighton	Chamb'lain-Hookham, Thom.-Hous. and Westinghouse	550 kw.	Local coal	£10,000	£20,000	5/8	—	87
2 250 kw., w. nearly e	Direct ..	Condensing....	Callender's concentric	38,500	130 arcs, 1 incandsnt.	12,863, inclu. arcs, 8 c.p.	6d., and on D. I. system at 7d. and 2d.	D. I. system	Thomson-Houston	1,360 kw.	Welsh coal	—	—	6/8	Throughout system	60
alt., 3 60 2 28 kw. 8 kw. arcs, v.	Direct ..	Condensing....	H.T. con. jute, ld. cov., & arm'rd & con. in pipes, L.T. I.R. and paper	33,000	77 arcs, 4 50 c.p. incan. 36 16 c.p., 5 25 c.p.	8,000....	Lgt. 6d. 1st hr. 3d. aft., pwr. 3d. 1st 12 h., 2d. nt. 18, 1d. rem.	Brighton	Aron, Thom'-Hous., Shallenberger, and Chamb'lain-Hookham	1,190 kw.	Screened peas	£85,000		—	—	40
1 75 kw., w., and 1	Direct ..	Condensing....	Silvertown and Callender's concentric	13,900 8 c.p.	40 arcs	2,390....	7d. and 3d. for light, 6d. and 3d. for power	Brighton	Thomson-Houston and Aron	475 kw.	Welsh coal	£75,690, inclu. of trac. plt.	£20,228	7/–	—	100
150, 1 50 Brush arc	Direct and rope	Non-condensing	Vulcanised rubber cables	23,000 8 c.p.	81 arcs	—	7d.	Sliding scale to 5d.	Shallenberger....	900 kw.	Welsh coal	£58,000	—	8/–	Distg. mains bg. changed from 100 v. to 200 v.	83
2 60 kw., 3 18 k.w., 2 300 kw.	Direct ..	Condensing....	Arm. con. cab. for H.T., Call. L.T., and Siemens H.T.	31,478 8 c.p.	75 arcs, 569 incandsnts.	9,964....	6d., 5d., 4½d. & 4d., power 3d.	Discount for cash	Thomson-Houston and Shallenberger	512 kw.	Pea and Welsh coal	£64,000	£30,000	—	None	40
70 kw., 130 kw., 1 100 v., 1 250 kw.	Rope and direct	Fow. and Mars. are condensing, others not	Mostly rubber in iron pipes	26,936 8 c.p.	25 arcs	4,500....	7½d., and 4d. for power or heating	L. hs. 7½d. 1st 2, 4d. af. others net	Shallenb'r, Chamberlain-Hookham and Aron	800 kw.	Welsh coal	£65,537	£14,519	8/4	262 16 c.p., 200 v.	83
, 1 25 kw. ators	Direct coupled	Ejector condensers	Glover cables, distributors laid in w'd'n troughing	7,184 8 c.p.	445 8 c.p...	7,184....	7d. first hour, 2d. after	Brighton	Chamberlain-Hookham	265 kw.	Coal, burgie & sl'ck mixed	£9,250	£4,897	Pr. 1/11, pub. ltg. 12/6	—	50
1 50 kw., 2 230 arc lgt., alt.	Rope, belt and direct	Non-condensing	Concentric arm'rd, laid in ground	18 arcs and 17,100 8 c.p.	33 arcs and 56 incandescents	4,000....	6d., with scale to 4d.	On lorg hour consumption	Shallnbgr., Thomson-Houston and Hookham	670 kw.	Welsh coal	—	—	—	None at present	100
50 kw. alt., t T.H. arc s	Belts, ropes & direct	Condensing....	Overhead Okonite cbls. & paper insltd. in stonewr. condts.	2,160 8 c.p.	27 arcs and 95 incandescents	160	7d.	No discount	Shallnbgr., Thomson and Chamberlain-Hookham	140 kw.	Welsh coal and small house	£11,000	£2,000	10/–	None	125
2 100 kw., , 2 350 kw.	Rope and direct	Condensing....	Vulcanised rubber cables, Callender	42 arcs, and 20,000 8 c.p.	31 arcs, 42 incandescents	5,000....	5d. lighting, 2½d. power	Discounts	Thomson and Chamberlain-Hookham	1,300 kw.	Yorkshire coal	£34,500	£14,800	6/9	New consumers	80
100 kw., 2 1 500 kw. & kw. & exci.	Rope and direct	Condensing....	H.T. Glo. & B.I.W. concen. L.T. B.I.W. & Callender's	33,827	70 arcs, 96 incandescents	4,923....	5d. & 2½d. ltg., 2½d. & 1d. mot and heating	Maximum demand	Shallenbr., Chamberl'n-Hookh'm, Thomson & Aron	1,224 kw.	Slack	£60,785	£21,000	5/4	None	100
1 25 kw.,	Direct	Condensing....	B.I.W. concentric cables, Siemens	23,700 8 c.p. and few arc lamps	55 arcs, and 16 incandescents	8,400....	6d.	Ltg. 6d. 4d., Pr. 6 3 2½d Htg. 6d. 3d.	Thomson-Houston, Chamb'lain-Hookham and Aron	575 kw.	Small steam coal	£35,000	£10,200	Abt. 6/–	—	50
1 50 kw., , 3 35 kw	Rope and direct	Condens. on por. plant, Wright's evap. condenser	Con. vul. in pipes & arm. diatrine, lead cov. paper diatrine	17,788	53 arcs	3,801....	1½d. unit, 10/- 8 c.p. lamp. ann , or 6d. unit	—	Shallenb'r, Chamb-'lain, Thom.-Hous Aron & new Shallb'r	655 kw.	Wayne's Merthyr	About £80,000	—	9/–	—	100
1 140 kw., 2 300 kw.,	Rope and direct	Condensing....	Paper, bitumen & rubber cables	70,178 8 c.p.	36 arcs and 54 incandescents	16,024 ..	4½d. lighting, 2½d. and 1d. power	Disct. according to consmptn.	Shallenberger, Thomson-Houston and Hookham	2,290 kw.	Slack	£65,000	£55,000	5/–	—	100
.....	Belt	—	Rubber and overhead	—	—	—	—	—	Thomson-Houston	—	—	—	—	—	—	—
25 kw. ..	Ropes ..	Condensing....	H.T. con. armrd. and vulc. rub. in Doulton pipes	2,860 8 c p.	5 arcs, 36 incandescents	300	6d., and by contract	—	Chamberlain-Hookham	110 kw.	Slack	—	—	8/–	None	100
2 50 kw., 1 20 kw., 2 20 1 200 kw.	Direct ..	Surface condensing	Concentric steel-armoured cables	18 arcs, 15,170 8 c.p.	41 arcs, 23 25 c.p. incandescts.	3,520....	6d. and 4d.	Brighton	Thomson-Houston, Shallenb'r, Hookham and Aron	445 kw.	Sm. coal in Lan. boil., lr. Welsh, Bab.	£27,500	£21,300	9/–	None	77
.....	Rope ..	Condensing....	Armoured concentric	2,000 8 c.p.	14 arcs and 109 incandescents	—	1½d. to 8d., generally by contract	—	Shallenberger	80 kw.	Coal	£11,000	—	—	None	100
rope drvn., ., 5 300 kw. kw. dir.	Rope and direct	Condensing....	Rubber cbls. in c.i. pipes, and paper cables concntrc.	101,223 8 c.p.	—	27,273 ..	4½d. to 5d.	Sliding scale	Shallenberger and Thomson-Houston	3,040 kw.	Local coal..	—	—	7/7	—	83
.....	Direct	Condensing. Jet condens. & pump on each engine	H.T. in pipes, L.T. arm. & laid direct in ground	196 arcs, 44,212 8 c.p. To. eq. 52,526	—	14,036 ..	5d. to 30/6/'99, 4d. since, 2d. for power	No discount	Aron, Chamberlain and Hookham	1,600 kw.	Coke.....	—	—	6/–	About 500, 200 v.	50
1 70 kw.	Direct and belt	Non-condensing	Callender and Silvertown in pipes	—	60 incandescents, 1 arc	—	£1 per ann per 16 c.p., or 5d. & 8d. per unit	—	Chamberlain and Hookham	147 kw.	Welsh coal	—	—	—	—	83 and 100
ach.....	Belt	Non-condensing	H.T. arm. fdrs. in ground., dists in glazed earthn. pip.	1,285 8 c.p. includg. 1 15 amp. arc	384 8 c.p. (incldg. 2 arcs 12 amp.)	First year of wrkg.	6d.	6d., public ltg. £30C per ann.	Shallenberger....	42 kw.	Frst. of Dean steam coal	—	—	—	None	60
lternators, lternator, exciter w.	Flywheel, direct	Non-condensing	Callender's cables armd. and laid in Doulton casing	6,031 8 c.p.	16 arcs, 33 incand.	Started Mar. 1, '98	5½d. with disc. from 2½ % to 25 % on qty.	—	Thomson-Houston & Chamberlain-Hookham	140 kw.	Coal	£22,000	About £5,000	—	—	60
.....	Direct ..	Both.....	Vulcanised rubber	60	10 arcs....	6,590....	6d.	Discnt. up to 35 %	Shallenbr., Thomson-Houston and Chambrln.-Hookm.	1,600 kw.	Small steam	£101,179	£24,711	6/8	None	80
.....	Rope ..	Condensing....	Cables in iron pipes	64,000	14 arcs	11,000 ..	4½d.	Discount	Thomson-Houston	990 kw.	Small steam	—	—	—	None	100
50 kw., 2 1 100 kw.	Ropes and direct	Condensing....	Siemens rubber cables, Glover diatrine	29,781 8 c.p.	76 arcs	7,516....	Lighting 6d. and 4d., pwr. 2d. and 1½d.	Sliding scale	Shallenberger and Thomson	1,050 kw	Abercarn small coal	£65,699	£18,260	5/8	None	87·5
2 200 kw.,	Direct ..	Jet condensers	C.C. vul. bit. H.T.,	Equivalt. to	63 15 amp.	All.....										

view" List of Electricity Works of

IGH PRESSURE ALTERNATING CU

of	Type of Generators.	Size of Generators.	System of Driving.	Condensing or Non-condensing.	System of Mains.	Number of Arcs and Incandescents used in Private Lighting.	Number of Lamps used in Street Lighting; Arc and Incandescent.	Number of 8 C.P. Lamps added during past 12 months.	Price Charged to Private Consumers.	System of Charging.	Type of Meters Employed on Consumers' Premises.	Present actual Capacity of Works in kw.	Nature of Fuel used.	Total Cost of Constructing and Equipping Works.
y) 75	2 Johnson-Phillips and 2 Brush arc	2 50 kw., 2 55 arc lighters	Rope and belt	Non-condensing	B.I.W. and Fowler-Waring lead cov. and arm'rd conc.	11 arcs and equivlts. of 2,500 8 c.p.	29 arcs....	1,200....	6d.	Meter ..	Chamberlain-Hookham	—	Anthracite and coke	—
h.p.	5 Edison-Swan	2 120 kw., 2 60 kw., 1 30 kw., 1 240 kw. erecting	Direct coupled and rope	Condensing....	H.T. concen. feeders and H.T. concentric distribtrs.	25,000 8 c.p.	—	7,000....	6d.	—	Shallenb'r, Chamb-'lain-Hookham and Thomson-Houston	360 kw., & 240 kw. etg.	Household screenings and burgie	£22,872
vert nd 2	5 Siemens	2 200 kw., 2 100 kw., 1 25 kw.	Direct flywheel alternators	Either	Callender's concentric	14,500 8 c.p.	90 arcs, 75 16 c.p. incandescent	4,923 in 6 months	6d. first hour, 4d. afterwards	Brighton	Thomson-Houston and Chamberlain-Hookham	625 kw.	Dross	£45,000
p.	4 Mordey alternators and 2 300 kw. direct alternators, E.C.Co.	4 75 kw., 2 300 kw.	Rope and direct	Condensing....	Callender's solid system	Equivalt. of 18,546 8 c.p. lamps	88 arcs, 13 50 c.p. incandescent	2,556....	6d. & 4½d. for lighting, 3d. for power	Discounts to large consumers	Shallenb'r, Chamb-'lain-Hookham and Thomson-Houston	900 kw.	Coal	—
, 2 p.	3 Johnson-Phillips, 2 Siemens, 2 Easton-Anderson	3 30 kw., 2 90 kw., 1 150 kw., 1 250 kw.	Direct ..	Surface condensers	Rubber cables in iron pipes or conduits	26,000 8 c.p.	527 lamp cols. with 2 incan. in each	8,000....	5d., less ½d. within 1 month	—	Chamb'lain-Hookham and Shallenberger	670 kw.	Hard steam coal and scrnd. peas	£28,500
h p. t(t). 000	Leeds and London, Ferranti, E.C.C., and Parsons	1 300 kw., 1 200 kw., 2 100 kw., 3 50 kw., 2 100 kw., 1 500 kw.	Rope and direct	Condensing....	Paper cbls. laid in troughs	60,200 8 c.p.	191 arcs ..	—	7d. first hour, 2d. after, churches, 5d., motors, 2½d.	Brighton	Shallenb'r, Thomson-Houston and Aron meters	1,550 kw.	Bituminous coal and coke	With extensions £162,500
200	Mordey and Ferranti	4 200 kw., 2 100 kw., 1 50 kw.	Ropes and direct	Both. Klein cooler	Rub. concen. fdrs., jute arm'rd distrs., B.I.W. for both.	56,000	5 arcs	10,000 ..	6d. first hr., 3d. af., or 5d. all rnd. 10% dis.	Brighton, &c.	Westinghouse, Thom.-Houston, and Ferranti	1,050 kw.	Slack, 10/4 and 12/–	£72,000
..	Mordey	1 350 kw., 1 150 kw., 2 100 kw., 5 60 kw.	Ropes and direct	Condens. Klein cool. Körting spray coolers	Arm'rd con. in grd., unarm'rd con. in pipes and conduits	44,000 8 c.p.	None	11,000 ..	7d. and 3½d.	Brighton	Thomson-Houston and Aron	1,000 kw.	Coke and small coal	—
v), 2	Kapp and Easton-Anderson-Goolden	2 60 kw. (Kapp), 1 75 (E.A.G.)	Belts and direct	Condensing, one engine	Lead cov. con. laid in grd., B.I.W.	4,889.....	30 arcs and 171 incn. of 25 & 32 c.p.	864	6d. and 3½d.	Meter ..	Shallenberger and Chamberlain-Hookham	195 kw.	Welsh steam coal and slack	£8, 51
..	Siemens and Ferranti	2 88 kw., 4 400 kw., 4 210 kw., 4 52 kw., 2 165 kw., 252 excit.	Direct ..	Surface condensing	Arm'rd lead concen in grnd.; distbrs., tri. con.; also six con. for arc cir.	82,580	312 arcs ..	16,576 ..	Lighting, max. 5d., min. 2½d.; power 1½d., min. 1½d	By meter and automatic clock	Thomson-Houston Shallenbrgr. and Aron	3,154 kw.	Coal, Welsh washed pea nut	£222,944, including mains, &c.
1	Lowrie-Hall	3 80 kw. each, 1 220 kw.	Rope and direct	Eject. condens., 1 machine jet condenser	H.T. feeders, con lead cov. paper in c.i. pipes.	10,970 8 c.p.	—	1,250....	6d. and 3d., power, 2½d.	Brighton system	Shallenb'r, Chamb-'lain-Hookham, and Thomson-Houston	660 kw.	Slack, coke, refuse from gas works	£30, 00
..	Parsons	1 35 kw., 1 60 kw., 3 100 k.w.	Direct ..	Condensing, jet and surface	H.T. feeders, rub. cables in pipes, B.I.W. triple con. distributors	3 arcs, 27,909 8 c.p.	1 arc.....	2,829....	7d. and 3½d. for ltg. & power, 3½d. for street ltg.	Hopkinson's max. demand	Shallenb'r & Thom. Houston, with Barker & Ewing's max dem. attacht.	395 kw.	Slack	£59, 18
.,	5 Siemens disc armature, and 1 Ferranti flywheel	2 40 kw., 2 180 kw., 2 300 kw.	Direct ..	Condensing....	Silvertown concentric, B.I.W. and Siemens	22,000 8 c.p.	63 arcs, 35 glow lamps	4,888....	6d. 1 hr., 3d. af., 2½d. pr. & htg., & 2d. 4000 p.an.	Brighton for lghtg. purposes	Thomson-Houston, Shallenberger, and Aron	1,040 kw.	Washed pea nut and nut coal	£71, 01
s	E.C.C. alternators at Milford	1 65 kw. alt., 1 50 kw. alt., 1 30 kw. dir. cur. dynamo	Belt	Non-condensing	Ovhd. to Carlow, lead cov. cbls. in Doulton con.	1,052 incandescents	18 arcs and 54 16 c.p.	140	7½d., with discounts	Meter ..	Thomson-Houston	145 kw.	Welsh coal	—
er	——	—	Belt	—	Paper cables	—	16 32 c.p. incandsnt.	—	10/– per 8 c.p. per annum	—	—	—	—	—
ll) 1	2 Brush and 2 Ferranti alternators, 1 Parsons	2 125 kw., 1 100 kw., 1 50 kw., 1 500 kw.	Ropes, belt and direct	Condensing....	Brooks, Glover's con.	9,400, equiv. 8 c.p.	—	3,050	5d.	Meter ..	Shallenberger, B. T. H., and Aron	900 kw.	Welsh coal and small	—
s)	Crompton	2 80 kw., 2 70 kw., 1 20 kw.	Direct ..	—	Rub. cbls. H.T. in Doult'n cndts. L.T. in iron pipes	2 arcs 5,250 8 c.p.	21 arcs, 240 30 c.p. incandes'nt	1,200....	6½d. with ½d. discount for cash	—	Mainly Thomson-Houston	320 kw.	Hard steam and Welsh	—
s) 2	Siemens	1 33 kw., 3 110 kw. 2 220 kw.	Direct ..	Condensing....	Armoured and unarmoured	22,700 8 c.p.	197 arcs, 18 incandsnts.	—	6d. to 3⅜d., 3d. for power and heat	Brighton, approx.	Mainly Thomson-Houston	800 kw.	Small coal	£33,700, st. lmps., £8,300
	Mordey	3 50 kw.	Rope ..	Independent condenser	H.T. con. & sngl. vul. rub., in c.i. pipes	—	8 arcs	—	7d. for first hour, and 3½d. after	Brighton	Thomson-Houston	150 kw.	Washed single nuts	—
,	Fowler & Co., and Fynn	1 50 kw., 1 100 kw., 2 200 kw.	Rope and direct	Condensing....	L.T. Callndr's. C.C. L.T. armoured concentric	16,600	40 arcs	6,600....	6d. and 3d.	Brighton	Chamb'lain-Hookham, Thom.-Hous. and Westinghouse	550 kw.	Local coal	£40,000
)	British Thomson-Houston ..	3 120 kw., 2 250 kw., 1 500 kw. nearly complete	Direct ..	Condensing....	Callender's concentric	38,500	130 arcs, 1 incandsnt.	12,863, inclu. arcs, 8 c.p.	6d., and on D. I. system at 7d. and 2d.	D. I. system	Thomson-Houston	1,360 kw.	Welsh coal	—
2)	Siemens disc alternators and arc machines, and Ferranti alternator	2 150 kw. alt., 3 60 kw. do., 2 28 kw. do, 3 18 kw. arcs, 1 600 k.w.	Direct ..	Condensing....	H.T. con. jute, ld. cov., & arm'rd & con. in pipes, L.T. I.R. and paper	33,000	77 arcs, 4 50 c.p. incan. 36 16 c.p., 5 25 c.p.	8,000....	Lgt. 6d. 1st hr. 3d. aft., pwr. 3d. 1st 12 h., 2d. nt. 18, 1d. rem.	Brighton	Aron, Thom'-Hous., Shallenberger, and Chamb'lain-Hookham	1,190 kw.	Screened peas	£85, 000
	Mordey, and G. E. dynamos for tramways	1 50 kw., 1 75 kw., 2 100 kw., and 1 150 kw.	Direct ..	Condensing....	Silvertown and Callender's concentric	13,900 8 c.p.	40 arcs	2,390....	7d. and 3d. for light, 6d. and 3d. for power	Brighton	Thomson-Houston and Aron	475 kw.	Welsh coal	£75,690, inclu. of trac. plt.
	E.C.C., Fowler, British Thomson-Houston	2 200, 3 150, 1 50 and 3 Brush arc lighters	Direct and rope	Non-condensing	Vulcanised rubber cables	23,000 8 c.p.	81 arcs	—	7d.	Sliding scale to 5d.	Shallenberger....	900 kw.	Welsh coal	£58,000
	Siemens	2 131 kw., 2 60 kw., 2 28 kw., 3 18 k.w., 2 10 kw., 2 300 kw.	Direct ..	Condensing....	Arm. con. cab. for H.T., Call. L.T., and Siemens H.T.	31,478 8 c.p.	75 arcs, 569 incandsnts.	9,964....	6d., 5d., 4½d. & 4d., power 3d.	Discount for cash	Thomson-Houston and Shallenberger	512 kw.	Pea and Welsh coal	£64,000
	E.C.C. and Fowler	2 40 kw., 2 70 kw., 1 30 kw., 1 150 kw., 1 100 kw., 1 50 kw., 1 250 kw.	Rope and direct	Fow. and Mars. are condensing, others not	Mostly rubber in iron pipes	26,936 8 c.p.	25 arcs	4,500....	7½d., and 4d. for power or heating	L. hs. 7½d. 1st 2, 4d. af. others net	Shallenb'r, Chamberlain-Hookham and Aron	800 kw.	Welsh coal	£65,537
	Johnson & Phillips	2 120 kw., 1 25 kw. motor altrnatr. and accumulators	Direct coupled	Ejector condensers	Glover cables, distributors laid in w'd'n troughing	7,184 8 c.p.	445 8 c.p....	7,184....	7d. first hour, 2d. after	Brighton	Chamberlain-Hookham	265 kw.	Coal, burgie & sl'ck mixed	£9,250
	Brush, Easton-Anderson, Thomson-Houston and Ferranti	2 75 kw., 1 50 kw., 2 100 kw., 2 30 arc lgt., 1 250 kw. alt.	Rope, belt and direct	Non-condensing	Concentric arm'rd. laid in ground	18 arcs and 17,100 8 c.p.	33 arcs and 56 incandescents	4,000....	6d., with scale to 4d.	On lor g hour consumption	Shallnbgr., Thomson-Houston and Hookham	670 kw.	Welsh coal	—
	Thomson-Houston, Johnson and Phillips	2 35 kw., 1 50 kw. alt., 2 30 light T.H. arc machines	Belts, ropes & direct	Condensing....	Overhead Okonite cbls. & paper insltd. in stonewr. condts.	2,160 8 c.p.	27 arcs and 95 incandescents	160	7d.	No discount	Shallnbgr., Thomson and Chamberlain-Hookham	140 kw.	Welsh coal and small house	£11,000
	E.C.C.	1 50 kw., 2 100 kw., 2 200 kw., 2 350 kw.	Rope and direct	Condensing....	Vulcanised rubber cables, Callender	42 arcs, and 20,000 8 c.p.	31 arcs, 42 incandescents	5,000....	5d. lighting, 2½d. power	Discounts	Thomson and Chamberlain-Hookham	1,300 kw.	Yorkshire coal	£34,500
	Mordey, Ferranti, and Brush arcs, 4 Ferranti 30-light rectifiers	2 50 kw., 2 100 kw., 2 arc 12 kw., 1 300 kw. & exci., 1 600 kw. & exci.	Rope and direct	Condensing....	H.T. Glo. & B.I.W. concen. L.T. B.I.W. & Callender's	33,827	70 arcs, 96 incandescents	4,928....	5d. & 2½d. ltg., 2½d. & 1d. mot and heating	Maximum demand	Shallenbr., Chamberl'n-Hookh'm, Thomson & Aron	1,224 kw.	Slack	£60,785
	Ferranti and Siemens	2 125 kw., 1 25 kw., 1 300 kw.	Direct	Condensing....	B.I.W. concentric cables, Siemens	23,700 8 c.p. and few arc lamps	55 arcs, and 16 incandescents	8,400....	6d.	Ltg. 6d. 4d., Pr. 6 3 2½d Htg. 6d. 3d.	Thomson-Houston, Chamb'lain-Hookham and Aron	575 kw.	Small steam coal	£35,000
	Mordey, and 3 35 kw. Crompton alternators	3 100 kw., 1 50 kw., 1 200 kw., 3 35 kw	Rope and direct	Condens. on por. plant, Wright's evap. condenser	Con. vul. in pipes & arm. diatrine, lead cov. paper diatrine	17,788	53 arcs	3,801....	1½d. unit, 10/- 8 c.p. lamp. ann, or 6d. unit	—	Shallenb'r, Chamb-'lain, Thom.-Hous Aron & new Shallb'r	655 kw.	Wayne's Merthyr	About £80,000
	Mordey, Ferranti and Siemens	1 100 kw., 1 140 kw., 1 250 kw., 2 300 kw., 2 600 kw.	Rope and direct	Condensing....	Paper, bitumen & rubber cables	70,178 8 c.p.	36 arcs and 54 incandescents	16,024 ..	4½d. lighting, 2½d. and 1d. power	Disct. according to consmptn.	Shallenberger, Thomson-Houston and Hookham	2,290 kw.	Slack	£65,000
	Kapp	2 30 kw.	Belt	—	Rubber and overhead	—	—	—	—	—	Thomson-Houston	—	—	—
	Mordey	1 60 kw., 2 25 kw. ..	Ropes ..	Condensing....	H.T. con. armrd. and vulc. rub. in Doulton pipes	2,860 8 c.p.	5 arcs, 36 incandescents	300	6d., and by contract	—	Chamberlain-Hookham	110 kw.	Slack	—
	Siemens	1 25 kw., 2 50 kw., 1 100 kw., 2 20 kw., 2 20 kw. excit., 1 200 kw.	Direct ..	Surface condensing	Concentric steel-armoured cables	18 arcs, 15,170 8 c.p.	41 arcs, 23 25 c.p. incandescts.	3,520....	6d. and 4d.	Brighton	Thomson-Houston, Shallenb'r, Hookham and Aron	445 kw.	Sm. coal in Lan. boil., lr. Welsh, Bab.	£27,500
	Mordey	2 40 kw.	Rope ..	Condensing....	Armoured concentric	2,000 8 c.p.	14 arcs and 109 incandescents	—	1½d. to 8d., generally by contract	—	Shallenberger	80 kw.	Coal	£11,000
	E.C.C., Fowler, and Ferranti	3 100 kw., rope drvn., 3 200 kw. do., 5 300 kw. dir., 1 640 kw dir.	Rope and direct	Condensing....	Rubber cbls. in c.i. pipes, and paper cables concntrc.	101,223 8 c.p.	—	27,273 ..	4½d. to 5d.	Sliding scale	Shallenberger and Thomson-Houston	3,040 kw.	Local coal..	—
	Ganz inductor alternators ..	4 400 kw.	Direct	Condensing. Jet condens. & pump on each engine	H.T. in pipes, L.T. arm. & laid direct in ground	196 arcs, 44,212 8 c.p. To. eq. 52,526	—	14,036 ..	5d. to 30/6/'99, 4d. since, 2d. for power	No discount	Aron, Chamberlain and Hookham	1,600 kw.	Coke.....	—
	Mordey and Lowrie Hall....	2 38½ kw., 1 70 kw.	Direct and belt	Non-condensing	Callender and Silvertown in pipes	—	60 incandescents, 1 arc	—	£1 per ann per 16 c.p., or 5d. & 8d. per unit	—	Chamberlain and Hookham	147 kw.	Welsh coal	—
2	Siemens	2 21 kw. each.....	Belt	Non-condensing	H.T. arm. fdrs. in ground., dists in glazed earthn. pip.	1,285 8 c.p. includg. 1 15 amp. arc	384 8 c.p. (incldg. 2 arcs 12 amp.)	First year of wrkg.	6d.	6d., public ltg. £300 per ann.	Shallenberger....	42 kw.	Frst. of Dean steam coal	—
	E.C.C.	2 125 kw. alternators, 1 20 kw. alternator, 1 35 kw. exciter	Flywheel, direct	Non-condensing	Callender's cables armd. and laid in Doulton casing	6,031 8 c.p.	16 arcs, 33 incand.	Started Mar. 1, '98	5½d. with disc. from 2½ % to 25 % on qty.	—	Thomson-Houston & Chamberlain-Hookham	140 kw.	Coal	£22,000
	Parsons turbo-alternators ..	75 to 500 kw.	Direct ..	Both.....	Vulcanised rubber	60	10 arcs....	6,590....	6d.	Discnt. up to 35 %	Shallenbr., Thomson-Houston and Chambrln.-Hookm.	1,600 kw.	Small steam	£101,179
	Mordey	1,370 kw.....	Rope ..	Condensing....	Cables in iron pipes	64,000	14 arcs	11,000 ..	4½d.	Discount	Thomson-Houston	990 kw.	Small steam	—
	Fowler and Hall.....	4 75 kw., 1 50 kw., 2 300 kw., 1 100 kw.	Ropes and direct	Condensing....	Siemens rubber cables, Glover diatrine	29,781 8 c.p.	76 arcs	7,516....	Lighting 6d. and 4d., pwr. 2d. and 1½d.	Sliding scale	Shallenberger and Thomson	1,050 kw	Abercarn small coal	£65,699
	Ferranti ironclad	1 600 kw., 2 200 kw., 1 100 kw. copper disc.	Direct ..	Jet condensers	C.C. vul. bit. H.T., C.C. ld arm'd L.T., vul. bit. cbls. for arcs	Equivalt. to 17,800 8 c.p. lamps	63 15 amp. arcs on	All.....	7d. and 3d.	Brighton max. for	Thomson-Houston and Aron	1,100 kw	Lanarkshire	£61,000
	2 Westinghouse 6-pole, 4 Fer-	2 100 kw. dynamos												

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G CURRENT.

Nature of Fuel used.	Total Cost of Construct-ing and Equipping Works.	Cost of Mains.	Annual Revenue per 8 C.P. Lamp.	Number of High Voltage Lamps used.	Periodicity.	Declared Pressure at Consumers' Terminals.	No. and aggregate H.P. of Motors connected.	Remarks.	Engineer-in-Chief.	PLACE.
										PROVINCIAL.
Anthracite and coke	—	—	—	200	100	100 v. and 220 v.	1 = 1 h.p.	—	E. E. Putland..	**Aberystwyth** ....(1)
Household screenings and burgie	£22,872	£9,125	—	—	80	100 v.	—	—	S. Joyce	**Altrincham**.....(2)
Dross	£45,000	£9,500	6/7	About 1,500 200 v., remainder changing	60	100 v. and 200 v.	2 = 12 h.p.....	—	Arthur J. Fuller	**Ayr**.....(3)
Coal	—	—	—	None	100	—	5 = 6 h.p.	—	G. F. Metzger..	**Bath** .....(4)
Hard steam coal and scrnd. peas	£28,500	£35,000	—	None	60	100 v.	10 = 65 h.p. ..	—	W. J. Hope Johnston	**Bedford** .....(5)
Bituminous coal and coke	With ex-tensions £162,500	£32,000	6/1	With one or two exceptions 200 v. used throughout	83	200 v.	7 = 14 h.p.....	—	Robt. C. Quin..	**Blackpool** .....(6)
Slack, 10/4 and 12/–	£72,000	£25,000	5/–	Intend changing over	83	100 v., and 230 v. when chg'd over	—	—	Arthur Ellis ..	**Bolton*** .....(7)
Coke and small coal	—	—	6/10	About 5,000 ..	100	100 v. and 200 v.	On mains, 7 = 5 h.p. At works, 7 = 71 h.p.	—	E. Ll. Ingram ..	**Bournemouth** ..(8)
Welsh steam coal and slack	£8,510		—	None	60	100 v.	—	—	G. Marshall-Harriss	**Bray (Ireland)** ..(9)
Coal, Welsh washed pea nut	£222,944, including mains,&c.	£80,853	7/10	—	93	105 v. or 210 v., 250 v. and 500 v. power	32 = 100 h.p...	—	H. Faraday Proctor	**Bristol*** .....(10)
Slack, coke, refuse from gas works	£30,000		4/9	None	75	100 v.	—	—	F. L. Ramsden	**Burton-on-Trent** (11)
Slack	£59,184		5/6½	20. Is to be eventually adopted	90	100 v. and 200 v.	6½ b.h.p.	—	John H. Barker	**Cambridge** ....(12)
Washed pea nut and nut coal	£71,018		6/11	5,000.....	40	100 v. and 200 v.	11 = 12¾ h.p. ..	—	N. Appelbee ..	**Cardiff**.....(13)
Welsh coal	—	—	—	—	-	100 v. and 200 v.	—	New system put in in last 18 months by Gilkes & Co.	W. M. Harris (Consulting (Engineer)	**Carlow** .....(14)
—	—	—	—	None	—	—	—	—	G. H. Reed....	**Chagford** .....(15)
Welsh coal and small	—	—	—	None	100	100 v.	1 = 8 h.p. on works	—	J. Moseley Williams	**Chatham** .....(16)
Hard steam and Welsh	—	—	7/8	None	—	—	—	—	J. P. Nelson....	**Chelmsford†** ....(17)
Small coal	£33,700, st. Imps., £8,300	£37,700	—	Extensions entirely on 200 volts	93	100 v. and 200 v.	3 = about 5 h.p.	—	Hamilton Kilgour	**Cheltenham** ....(18)
Washed single nuts	—	—	—	None	100	100 v.	—	—	C. P. Sparks (ch.) J. B. McIndoe (resident)	**Coatbridge** ....(19)
Local coal	£40,000	£20,000	5/8	—	87	200 v.	6 = 12 h.p.	—	G. S Ram	**Coventry** .....(20)
Welsh coal	—	—	6/8	Throughout system	60	200 v.	9	—	T. Herbert Minshall	**Croydon** ..... (21)
Screened peas	£85,000		—	—	40	102 v. and 205 v.	31 = 146 h.p. ..	—	T. P. Wilmshurst	**Derby*** .....(22)
Welsh coal	£75,690, inclu. of trac. plt.	£20,228	7/–	—	100	100 v.	—	—	L. W. Woodman	**Dover*** .....(23)
Welsh coal	£58,000	—	8/–	Distg. mains bg. changed from 100 v. to 200 v.	83	200 v.	20 e.h.p.	New sta. abt. to be erected & mains extd., £250,000	Mark Ruddle ..	**Dublin**.....(24)
Gas and Welsh coal	£64,000	£30,000	—	None	40	102 v.	9	Superhtrs. being fitted to all boilers	J. Douglas Knight	**Ealing**.....(25)
Welsh coal	£65,537	£14,519	8/4	262 16 c.p., 200 v.	83	100 v. and 200 v.	12 = 10 h.p. ..	Taken over by Corporation, Jan. 1st, 1900	J. K. Brydges ..	**Eastbourne** ....(26)
Coal, burgie & sl'ck mixed	£9,250	£4,897	Pr. 1/11, pub. ltg. 12/6	—	50	200 v.	None	Started Dec. 1898. Av., priv. ltg., 4·8d. pub. lighting, 2·5d.	James Moss....	**Eccles** .....(27)
Welsh coal	—	—	—	None at present	100	100 v.	4 = 6 h.p.	—	H. D. Munro ..	**Exeter**.....(28)
Welsh coal and small house	£11,000	£2,000	10/–	None	125	100 v.	—	—	Arthur Blake ..	**Fareham** .....(29)
Yorkshire coal	£34,500	£14,800	6/9	New consumers	80	200 v.	—	—	H. F. Street ..	**Halifax***.....(30)
Slack	£60,785	£21,000	5/4	None	100	100 v.	11 = 25 h.p. ..	—	C. A. Cowell ..	**Hanley**.....(31)
Small steam coal	£35,000	£10,200	Abt. 6/–	—	50	100 v. and a few at 200 v.	6 = abt. 1½ h.p., and a 20 h.p. to be connected	—	G. Wilkinson ..	**Harrogate** ....(32)
Rayne's Merthyr	About £80,000	—	9/–	—	100	200 v.	3 = ½ h.p. each	—	L. Andrews....	**Hastings** .....(33)
Slack	£65,000	£55,000	5/–	—	100	100 v. and 200 v.	40 = 85 h.p. ..	—	A. B. Mountain	**Huddersfield** ..(34)
—	—	—	—	—	—	—	—	—	A. W. Thomas	**Keswick†** .....(35)
Slack	—	—	8/–	None	100	100 v.	—	Station plant rear., 100 h.p. tur. & 100 kw. alt. bg. add.	J. T. Mountstephen	**Killarney** .....(36)
Gas coal in Gen. boil., lr. Welsh, Bab.	£27,500	£21,300	9/–	None	77	105 v.	3 = 6 h.p.	Cables to riverside for launch charg'g with cur. fm. excit.	J. E. Edgcome (con. eng.)	**Kingston-on-Thames** (37)
Coal	£11,000	—	—	None	100	100 v.	—	—	M. G. Smyth ..	**Larne** .....(38)
Local coal..	—	—	7/7	—	83	100 v. and 200 v.	70 h.p.	—	H. Dickinson ..	**Leeds** .....(39)
Slack.....	—	—	6/–	About 500, 200 v.	50	100 v. and 200 v.	30 = 87½ h.p...	—	A. Colson.....	**Leicester** .....(40)
Welsh coal	—	—	—	—	83 and 100	100 v. and 84 v.	None	—	P. T. Kimmins	**Lynton and Lynmouth** (41)
Mst. of Dean steam coal	—	—	—	None	60	102 v.	2 = 10 b.h.p. (sewage pumpg.)	—	A. W. Blake ..	**Monmouth**.....(42)
Coal	£22,000	About £5,000	—	—	60	200 v.	5 = 25 h.p.	—	Herbert Drewett	**Morley (Yorks)** (43)
Small steam	£101,179	£24,711	6/8	None	80	100 v.	11 = about 80 h.p.	—	W. D. Hunter..	**Newcastle-on-Tyne** (44)
Small steam	—	—	—	None	100	100 v. or 50 v.	—	—	D. Walker	**Newcastle-on-Tyne** (45)
Abercarn small coal	£65,699	£18,960	5/8	None	87·5	100 v.	3 e.h.p.....	—	C. D. Copland	**Newport**.....(46)
Monmarkshire	£61,000	£14,000	Not	2,000, all glow	50					

(45) Newcastle-on-Tyne	Newcastle Electric Ltg. Co.	Sub-stats. and house transformers	Lanc.	Robey horizontal, 2 500 h.p.	Mordey	1,370 kw.....
(46) Newport	Corporation	Street and house transformers	7 Lanc. ..	4 com. 150 h.p., 1 com. 120 h.p., 2 500 h.p. horiz., 1 200 h.p. vert.	Fowler and Hall.....	4 75 kw., 1 50 kw 300 kw., 1 100
(47) Paisley	Town Council	Sub-station transformers, 2 wire dist.	6 Babcock and Wilcox	1 (Adamson) hor. com. 1,000 i.h.p., 1 (Ferranti) vert. com. 175 i.h.p., 2 do. vert. com. 350 i.h.p. each	Ferranti ironclad	1 600 kw., 2 200 1 100 kw. co disc.
(48) Plymouth.....	Town Council	Sub-station transformers, 3 wire L.P.	3 Lanc. ..	2 (Belliss) 150 b.h.p., 2 (Ferranti) 300 b.h.p.	2 Westinghouse 6-pole, 4 Ferranti disc armature	2 100 kw. dyna 2 100 kw., 2 200
(49) Portsmouth ..	Corporation	Street transformers	9 Lanc. ..	3 400 i.h.p., 1 (Parsons) turbo set 150 kw., 2 1,000 i.h.p., 600 kw.	Ferranti, Parsons and Richardson	3 212 kw., 1 150 2,600 kw.
(50) Prescot District	British Insulated Wire Co., Ltd.	Sub-station transformers	2 Lanc. ..	2 com. 100 h.p., 1 com. 35 h.p., 2 com. 220 h.p. high speed (Browett-Lindley), and others	Ferranti, Mordey and Johnson and Phillips	2 54 kw., 1 25 and 2 120 kw.
(51) Reading‡	Reading Electric Supply Co., Ltd.	Sub-stn. trns. for outlyng. & l.p.c. cntl.dists.	4 Lanc. ..	3 200 i.h.p. horiz., slow speed compound cond. engines, 2 (Belliss) 350 i.h.p.	Hall altrnatrs., E.C.C. dynamos	125 kw., 200 kw.
(52) Redditch	Urban District Council	Sub-station transformers	Dowson gas producers	2 (Premier Gas Engine Co.) 150 b.h.p. tandem gas engines, 1 50 b.h.p. do.	Johnson-Phillips alternators	2 100 kw., 1 35 kw
(53) Rugby	Rugby School Electric Ltg. Co.	House transformers	Dowson gas producers	Gas engines, 1 80 h.p., 1 65 h.p.	Brush, Nalder and Harrison	1 50 kw., 1 35 kw
(54) St. Helens†	Corporation	Sub-station transformers	2 Lanc. ..	Coupled compound condensing, Robey	Johnson & Phillips revolving fields, embedded armature coils	1 125 kw., 1 25 k
(55) Salford	Corporation	Sub-statn. and house trans., & bat. sub-sta.	3 Lanc. ..	3 (Browett-Lindley) com. 200 h.p. each	Mather and Platt	3 120 kw.....
(56) Scarborough ..	Scarborough Electric Ltg. Co.	Sub-station and house transformers	3 Lanc. ..	Parsons turbines, 4 150 kw., 1 75 kw.	Parsons	4 150 kw., 1 75 k
(57) Sheffield	Corporation	Sub-station transformers	Water-tube and marine	Compound and triple expansion engines	Ferranti and Brush	2 600 kw., 3 300 1 125 kw., 1 100
(58) Southport	Corporation	Sub-station transformers	6 Lanc.....	2 (Musgrave) 250 h.p. 1 do. 500 h.p., 1 do. 1,000 h.p.	Ferranti	2 125 kw., 1 300 1 600 kw.
(59) South Shields..	Corporation	Sub-station transformers	Marine....	Triple expansion	Ferranti and Siemens.....	2 100 kw., 2 200 1 500 kw.
(60) Taunton	Corporation	Sub-stats. and house transformers	3 Babcock & Wilcox, 1 Paxman	2 (Belliss) 300 h.p., 1 (Belliss) 200 h.p., 2 (Willans) 135 h.p., 1 (Chandler) 50 h.p.	Thomson-Houston	2 150 kw., 2 75 kw Ferranti rectif for arc lighting
(61) Torquay	Corporation	Street transformers and sub-stations	B. & W. water tube	3 (Willans) 250 h.p.	Fynn inductor alternators ..	125 kw. each ...
(62) Tunbridge Wells	Corporation	Sub-station transformers	Wtr. tb. with super heaters and 2 Lancs.	Willans and Ferranti	Johnson and Phillips and Ferranti	1 400 kw., 3 80 1 40 kw.
(63) Wakefield	Corporation	Sub-station transformers	2 Lanc.....	3 (Fowler) 180 h.p., 1 (Belliss) 50 h.p.	Fowler.....	3 112 kw., 1 28 k
(64) Wallasey	Urban District Council	Sub-station & house transformers	2 Lanc., 1 water tube	Compound vertical, 2 125 h.p., 1 500 h.p. (Browett-Lindley) and (Ferranti)	Ferranti	2 75 kw., 1 200 k and 1 300 kw.
(65) Watford	Urban District Council	L.P. from trans. under the streets	Babcock & Wilcox	2 (Raworth Universal) 250 h.p., 1 50 h.p.	Mordey inductor alternators	2 150 kw., 1 30 kw
(66) West Ham	Corporation	Sub-station trans., and trans. boxes	4 Lanc. & 3 Babcock & Wilcox	3 350 h.p., 1 150 h.p., 2 1,800 h.p. erecting	Ferranti	3 200 kw., 1 100 2 1,200 kw. erec
(67) Woking.....	Woking Elec. Supply Co., Ltd.	Sub-statn. and street box transformers	2 water tube, 3 fire tube	1 (Belliss) 125 h.p., 1 (Parsons) 125 h.p., 2 (Renshaw) 75 h.p.	Parsons and Brush	2 75 kw., 2 37½ k
(68) Worcester	Corporation	Sub-stns. and house transformers	Water tube boilers	2 54 h.p. (Victor turbines), 1 48 h.p. do., 1 36 h.p. do., 1 700 h.p. (Ferranti engine)	Mordey and Ferranti	4 125 kw., 1 400 k
(69) Yarmouth	Corporation	Sub-station transformers	4 water tube	2 300 h.p., 3 150 h.p., 2 60 h.p. ..	Crompton	2 150 kw., 3 75 k 1 15 kw., 4 15 k (arc lighters)

LONDON.

(70) City*	City of Lndn. Electric Ltg. Co.	Sub-stn. trans. & continuous current direct	Water tube, Babcock, & marine	Brush, Willans, Ferranti, Allis, Musgrave, Sissons, Browett-Lindley, Chandler	Mordey, Ferranti, British Thomson-Houston, Westinghouse	400 kw. to 1,800
(71) Hammersmith	Vestry	Trans. fixed in sub-stns., 2 wire dist.	3 water tube, 1 Lanc.	3 (McLaren) 220 h.p., 1 (Belliss) 50 h.p., 3 (Robey) 500 i.h.p.	5 Ferranti flywheel, 2 E.C.C. ironclad 300 kw.	1 25 kw., 3 125 3 300 kw.
(72) Hampstead	Vestry	Sub-station transformers	4 Lanc., 4 Ellis-Eaves	2 (Willans) 290 h.p., 2 do. 145 h.p., 1 do. 30 h.p., 2 do. 29 h.p., 3 do. 22 h.p., 2 (Ferranti) 500 h.p., 2 (Willans) 560 h.p., 1 (Belliss) 80 h.p.	Siemens and Ferranti	2 200 kw., 2 100 3 18 kw., 3 13 4 350 kw., 1 50
(73) Islington	Vestry	Street transformers	8 Lanc., 4 w. t. & 6 w. t. in progress	4 horiz. 250 i.h.p., 3 horiz. 500 i.h.p., 1 vert. 80 i.h.p., and 3 1,000 h.p. in progress	Ferranti, Fowler & Crompton	4 125 kw., 1 40 3 300 kw. and 3 kw. in progress
(74) Kensington	The Brompton & Kensi'gt'n Elec. Supply Co., Ltd	Sub-stats. and street transformers	17 boilers..	1 600 h.p., 5 325 h.p., 2 250 h.p., 2 140 h.p.	E.C.C.	1 350 kw., 5 200 2 150 kw., 2 kw.
(75) London*	Metropolitan Electric Supply Co.	Sub-station & house trans. and direct	Water tube and marine	Willans, Allen, Hornsby, Parsons, Westinghouse	Kapp, Johnson-Phillips, Siemens, Latimer Clark, Parker, Parsons and Westinghouse	120 to 1,500 kw. .
(76) London	London Electric Supply Corporation.	Sub-statn. and house transformers	Water tube and Economic	Hick Hargreaves, and Plenty & Son	Ferranti	—
(77) London	South London Elec. Supply Corporation	Two-wire L.T. net-work trns. in pits	Babcock & Wilcox	2 (Ferranti) 400 h.p., 1 do. 1,500 h.p., 1 (Yates-Thom.) 750 h.p. (1 1,500 h.p. being erected)	3 Ferranti, 1 British Thomson-Houston	2 250 kw., 1 1,000 1 500 kw.
(78) St. Luke's and Clerkenwell*	Cnty. of Lndn. & Br'sh. Prov. Elec. Ltg. Co.	1-phase and 2-phase A.C. sub-stn. trns. & C.C. 530 v.	12 water tube boilers	11 vert. comp. engines 250 h.p., 2 horiz. cross compound	5 Mordey, 6 E.C.C., and 2 B.T.H. multipolar	150 kw., 525 kw.
(79) Wandsworth ..	Cnty. of Lndn. & Br'sh Prov. Elec. Ltg. Co.	High & ex. hgh. presur. A.C., sub-station transformers	8 water tube boilers	6 Universal engines 250 h.p.	Mordey	150 kw. each ...

* Employing both Alternating and Continuous Current.
† No Return to hand.
‡ Combined High and Low Pressure.

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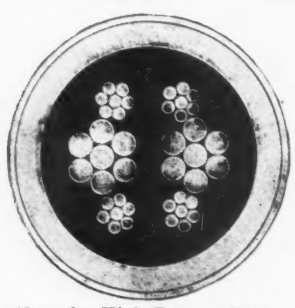
LIMITED,



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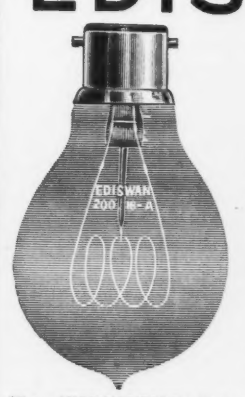

16 c.p. HIGH VOLTAGE LAMP, 200 volts. (HALF SIZE.)
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....	1,370 kw.....	Rope ..	Condensing....	Cables in iron pipes	64,000	14 arcs	11,000 ..	4½d.	Discount	son-Houston and Chamberln.-Hookm. Thomson-Houston	990 kw.	Small steam	—	—	—	None ....
....	4 75 kw., 1 50 kw., 2 300 kw., 1 100 kw.	Ropes and direct	Condensing....	Siemens rubber cables, Glover diatrine	29,781 8 c.p.	76 arcs	7,516....	Lighting 6d. and 4d., pwr. 2d. and 1½d.	Sliding scale	Shallenberger and Thomson	1,050 kw	Abercarn small coal	£65,699	£18,260	5/8	None .....
....	1 600 kw., 2 200 kw., 1 100 kw. copper disc.	Direct ..	Jet condensers	C.C. vul. bit. H.T., C.C. ld arm'd L.T., vul.bit.cbls.for arcs	Equivalt. to 17,800 8 c.p. lamps	63 15 amp. arcs on rectifiers	All.....	7d. and 3d.	Brighton max. for 1 hr. daily	Thomson-Houston and Aron	1,100 kw	Lanarkshire dross (soft Scotch)	£61,000	£14,000	Not compltd.	2,000, all glow lamps
Fer-	2 100 kw. dynamos, 2 100 kw., 2 200 kw.	Direct coupled	Condensing, sea water and ejector condenser	H.T. rdrs. ld. con., L.P. trpl.con.ld.cv., twin l.c. ar. & sgl.do.	24 arcs, abt. 12,000 8 c.p.	74 arcs, 4 incandescent	All.....	4½d.	No discts. or sliding scale	Shallenberger....	600 kw.	Welsh steam coal	£56,000	£9,000	—	2,000.....
dson	3 212 kw., 1 150 kw., 2,600 kw.	Direct ..	Condensing....	Con., Jennings conduits, and B.I.W. concen.	24 arcs, 71,000 8 c.p.	264 arcs, 470 32 c.p., & 16 16 c.p.	—	4½d. lighting, 2½d. power	—	Shallenberger, Thomson, and Hookham	1,986 kw.	Small bituminous	£140,000		7/6	None .....
ohn-	2 54 kw., 1 25 kw. and 2 120 kw.	3 by ropes and 2 dir. coupled	Surface condensing	B.I.W. paper cbls., lead cov. & armd. also solid system	2 arcs and 4,257 incandesc'nt	23 arcs, 114 incand.	1,700....	5d. and 3d.	Sliding scale	Thomson-Houston and Shallenberger	373 kw.	Steam coal	£25,000		5/–	None .....
yna-	125 kw., 200 kw. ..	Direct ..	Condensing....	Concentric armd., single distrbutrs. for continuous	25,000 8 c.p.	—	9,000....	6d. to 4d. ltg., 3d. to 1½d. power	Discounts and time switch	Chambrln.-Hookm. Thomson-Houston, Westinghouse	775 kw.	Welsh steam coal	£50,000	£25,000	5/6	20,000 .....
tors	2 100 kw., 1 35 kw...	Link belts	—	H.P. con. pr cov., ld.sh. & arm'd, L.P. con.l.sh., laid in gd.	4 arcs, equiv. of 4,500 8 c.p. lamps	270 32 c.p. incandsnt.	—	5½d., 5d. from 5 p.m. till 10 p.m., 2d. aft.	—	Chamberlain-Hookham	235 kw.	Anthracite	£13,000	—	—	—
ison	1 50 kw., 1 35 kw. ..	Belts....	Non-condensing	Concentric, lead covered	2 arcs, equv. of 3,800 8 c.p.	—	350	5d. and 4d., plus a fixed charge	Meter ..	Shallenberger, Chamberlain-Hookham & Aron	85 kw.	Coal and coke	£4,950		6/–	None .....
ving ture	1 125 kw., 1 25 kw.	Direct ..	—	Concentric and paper	34 arcs, 5,750 8 c.p.	4 arcs	1,724....	6d. light, 4d. power and heat	Meter, no discount	Thomson-Houston, Chamberlain-Hookham & Aron	150 kw.	Slack	£13,500	£2,500	5/6	None .....
....	3 120 kw.....	Ropes ..	Condensing....	Paper cables and fibrous, arm'rd & drawn in system	48,000	2 arcs	8,000....	6d. 1st hr., 2d. after; pwr. 3½d. 1st hr., 1d. afr.	Sliding scale	Shallenberger, Thomson-Houston and Hookham	360 kw. & 225 kw. batteries	Gas coke ..	£95,000	£37,000	—	200 v., 36,000 8 c.p.
....	4 150 kw., 1 75 kw.	Direct ..	Jet and surface	H.T. Silvertn. cbls. in c.i. pipes and B.I.W.con. for L.T.	27,171 8 c.p., includes 308 for motors	—	4,671....	6½d. to 5½d., ovr. £75 7d. 1st hr., then 3d.	Discounts	Hookham, Shallenberger, Thomson-Houston	675 kw.	Steam coal and coke breeze	£23,590	£20,350	4/7	609 .....
....	2 600 kw., 3 300 kw., 1 125 kw., 1 100 kw.	Direct ..	Condensing....	Paper cables and bitumen conduit	99,570 8 c.p.	—	25,717 ..	4d.	Uniform charge of 4d.	Thomson-Houston Shallenberger, Aron, & Hookham	2,325 kw.	Hard slack	£136,600	£60,120	6/–	500 .....
....	2 125 kw., 1 300 kw., 1 600 kw.	Direct ..	Condensing....	H.T. & L.T. paper & jute, lead cov., arm'd concentric	42,378	43 arcs, 15 amp.	10,140 ..	6d., 4d., & 2d. for lighting 6d. & 2d. pwr.	Brighton	Shallenberger, Thomson-Houston, Hookham, & Aron	1,150 kw.	Slack	£45,215	£47,300	6/–	All outlying districts
....	2 100 kw., 2 200 kw., 1 500 kw.	Direct ..	Condensing....	H.T. rub. concen., H.T. paper, L.T. paper and rub.	23,732 8 c.p.	65 arcs and 250 incandescent	11,482 ..	7d. and 2d., 2d. power	Brighton	Thomson-Houston and Chamberlain-Hookham	900 kw.	Unscreened coal	£80,000	£20,000	6/6	—
....	2 150 kw., 2 75 kw., 3 Ferranti rectifiers for arc lighting	Direct coupled	Condensing, jet condensers	Armoured concentric cables	21,500 8 c.p.	67 arcs, 250 incandsnt.	5,000....	6d. to 3½d.	Brighton	Thomson alone ..	450 kw.	Welsh smokeless coal	—	—	—	Extensions, 3,000
s ..	125 kw. each	Direct ..	Condensing....	Concentric H.T. feeders and L.T. distributors	9,956 8 c.p., 2 300 watt arcs	52 rect. 600 watt arcs, 103 32 c.p. incan.	3,456....	7d. first hour, 3d. after	Wright's	Aron, Thomson, and Chamberln.-Hookham	375 kw.	Coal	£24,969	£5,589	—	All.....
d anti	1 400 kw., 3 80 kw., 1 40 kw.	Direct ..	Condensing....	Armoured concentric cables	32,000 8 c.p.	60 arcs, 300 incandescents	9,000 ..	6d. and 3d., power 3d.	Demand system on 1 hr. basis	Aron, Westnghse.. Chambrln.-Hookm. & Thoms'n-Houst'n	680 kw.	Welsh coal (raily. rate 11/10 ton)	£42,000	£11,500	5/2	All.....
....	3 112 kw., 1 28 kw.	Direct ..	Condensing, jet	Armoured concentric, triple and 3 core	14,000	16 arcs	3,900....	6d. first hour, 3d. after	Brighton	Westinghouse and Thomson-Houston	390 kw.	Smudge coal	£29,000	£6,500	5/1	Distbutn. entrly on 200 v., 3 wire 400 v. acr. outer
....	2 75 kw., 1 200 kw., and 1 300 kw.	Direct ..	Condensing....	B.I.W. armoured cable	14,041 8 c.p.	19 arcs	5,398....	6d. to 4d., on free wiring sys. 7d. to 5d.	Sliding scale	Westinghouse and Chamberlain-Hookham	650 kw.	Coke.....	£25,838 to 31/3/'99	£6,170	—	None .....
tors	2 150 kw., 1 30 kw...	Direct coupled	Non-condensing	Henley.....	Equivalt. of 6,300 8 c.p.	Equivalt. of 2,000 8 c.p.	—	6d.	8d. & 3d., Wright's mx. dmd.	Chamberlain-Hookham	330 kw. (without reserve)	Nottingham steam coal	—	—	—	—
....	3 200 kw., 1 100 kw., 2 1,200 kw. erecting	Direct ..	Condensing....	B.I.W. con. ld. cov. arm. ld. dir., B.I.W. con. ld. cov. in pipes	20,794	88 enclosed arcs, 42 8 c.p. incand.	3,794 ..	7d. one hour and 3d. after, pwr. 5d. & 2d.	Wright's	Thomson-Houston and Chamberlain-Hookham	700 kw.	North Country small coal	About £50,000	About £15,000	—	—
....	2 75 kw., 2 37½ kw.,	Belt and direct	Surface condensing	Vulcanised rubber cables	5 arcs, &c.	130 incandescents	1,800....	8d.	Discounts on quantity used	Shallenberger and Thomson-Houston	225 kw.	Welsh coal	—	—	—	None .....
	4 125 kw., 1 400 kw.	Ropes and direct	Condensing....	Brooks semi-solid B.I.W. or Callender's	28 arcs and 31,000 8 c.p.	56 arcs and 15 incandescent	3,800 (approx.)	6d. and 2½d..	Brighton	Hookham, Thomson-Houston	900 kw.	Large Welsh	£74,000 (approx.)	—	1897, 4/10¾	About 1,000 of 200 v.
....	2 150 kw., 3 75 kw., 1 15 kw., 4 15 kw. (arc lighters)	Direct and rope	Surface condensers	Concentric, paper	19,500 8 c.p.	75 arcs	4,500....	6d. lighting, 3½d. power	—	Shallenberger, Thomson, and Hookham	600 kw.	Coal and gas coke	—	—	6/6	None .....
tish ting-	400 kw. to 1,800 kw.	Direct ..	Condensing....	Concentric cable.	430,000 8 c.p.	507 arcs, Markets 33 arcs	75,000 ..	4½d.	Sliding scale	Shlngr., Westghs., British Thomson-Houston, and Aron	—	Small coal and large Welsh	£712,887	£488,747	—	—
C.C.	1 25 kw., 3 125 kw., 3 300 kw.	Direct ..	Condensing....	Callender concen. in c.i. pipes	24,700	150	—	6d. one hour, 3d. after	Brighton and Manchstr.	Chamberlain-Hookham	1,300 kw.	Welsh coal	£85,000	£30,000	10/10	None.....
....	2 200 kw., 2 100 kw., 3 18 kw., 3 13 kw., 4 350 kw., 1 50 kw.	Direct ..	Non-condensing	Siemens, Glover, and B.I.W. paper, Siemens 3 core	100,451 8 c.p.	58 arcs	22,360 ..	6d. and 2½d.	Brighton	Thomson, Shallenberger, and Aron	2,243 kw.	Welsh coal	To March, '99 £51,768		6/4	None .....
oton	4 125 kw., 1 40 kw., 3 300 kw. and 3 600 kw. in progress	Direct and ropes	Non-condensing	Rubber concentric, steel armoured	32,000 8 c.p. (approx.)	330 arcs, no incandsnt.	8,268....	7d. to 4d., power & day supply 3½d.	Modified Brighton	Chmbrlin.-Hookm., Westnhs., T.-Hous., Aron (in progress)	1,460 kw.	Welsh coal	£230,000 (approx.) gross total	£80,000 (approx.)	—	All extensions 200 v.
....	1 350 kw., 5 200 kw., 2 150 kw., 2 80 kw.	Direct ..	1,000 h.p. condensing	Paper cables	95,303 8 c.p.	7 arcs, 14 incandescent (trial)	15,002 ..	6d., with special discts.	—	Westinghouse, Thomson-Houston and Aron	1,810 kw.	Anthracite, &c.	—	—	—	None.....
Sie- ker, se	120 to 1,500 kw.	Direct and ropes	Both.....	Paper and rubber cables	500,000 8 c.p.	20 arcs	67,000 ..	6d.	Sliding scale	Thomson-Houston, Shallenberger, and Aron	—	Welsh coal	—	—	—	Not many, but extending
....	—	Ropes and direct	Condensing....	Paper and jute ..	—	—	—	6d. p. unit with sliding scale, also demand indicator	Meter registration	Various	—	Welsh steam coal	—	—	—	—
om-	2 250 kw., 1 1,000 kw., 1 500 kw.	Direct ..	Non-condensing	H.T. fdr. netwk sup. plyg. L.T. distrs thro' trans. in st.	26,000 8 c.p.	—	1,300....	6d.	—	Shallenberger and Thoms'n-Houst'n	2,000 kw.	Coal refuse	£200,000	£60,000	8/–	All.....
d 2	150 kw., 525 kw. ..	Direct ..	Condensing....	H.T. paper con. power cbls., rubber conc. & arm'd, in c.i. pipes	49,711	—	17,252 ..	7d. 1st 1½ hrs'. ltg. then 3d., 4d. first hr., then 2d. pwr.	Brighton	Thomson-Houston	2,700 kw.	Small rough coal	—	—	7/–	—
....	150 kw. each	Direct ..	Condensing....	H.T. arm'rd, con. rub. L.T. lead cov. bitumenised fibre	47,150	—	18,524 ..	7d. 1st 1½ hrs.' ltg. then 3d., 6d. 1st hr's. pwr. then 3d.	Brighton	Thomson-Houston	900 kw.	Small rough coal	—	—	7/–	All.....

DISWAN

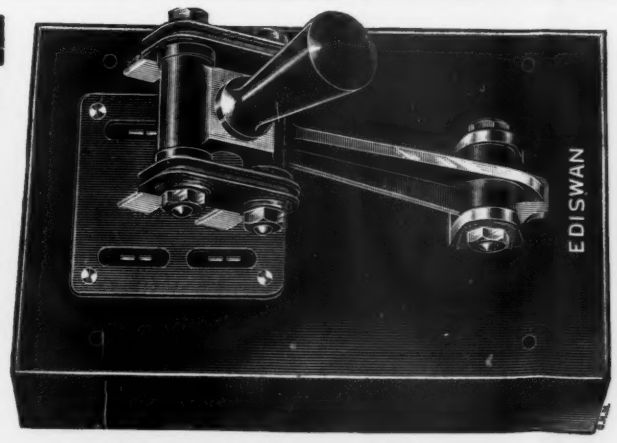
HIGH-TENSION FITTINGS.

ALTERNATORS.

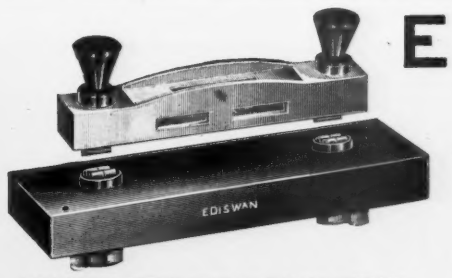
TRANSFORMERS.

ALTERNATING CURRENT BOOSTERS.

LTAGE LAMP, (HALF SIZE.)



2,000 VOLT SWITCHES UP TO 200 AMPERES.



2,000 VOLT SWITCH FUSE UP TO 200 AMPERES.

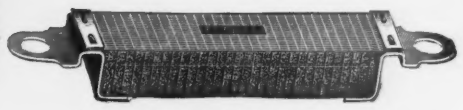


ILLUSTRATION OF REFILL FOR ABOVE.

EDISWAN

SWITCHBOARDS.

SWITCHES.

CUT-OUTS

RESISTANCES.

FUSE-BOARDS.

CEILING-ROSES.

16 c.p. STANDARD LAMP, 100 volts. (HALF SIZE.)

THE EDISON AND SWAN UNITED ELECTRIC LIGHT Co., Ltd., Head Offices, Warehouse and Showrooms, EDISWAN BUILDINGS, QUEEN STREET, LONDON, E.C.

.....	Mordey	1,870 kw.....	Rope ..	Condensing....	Cables in iron pipes	64,000	14 arcs	11,600 ..	4½d.	Discount	Thomson-Houston	800 kw.	Small steam	—
) h.p., . vert.	Fowler and Hall.....	4 75 kw., 1 50 kw., 2 300 kw., 1 100 kw.	Ropes and direct	Condensing....	Siemens rubber cables, Glover diatrine	29,781 8 c.p.	76 arcs	7,515....	Lighting 6d. and 4d., pwr. 2d. and 1½d.	Sliding scale	Shallenberger and Thomson	1,050 kw	Abercarn small coal	£65
i.h.p., i.h.p., each rranti)	Ferranti ironclad	1 600 kw., 2 200 kw., 1 100 kw. copper disc.	Direct ..	Jet condensers	C.C. vul. bit. H.T., C.C. ld arm'd L.T., vul. bit. cbls. for arcs	Equivalt. to 17,800 8 c.p. lamps	63 15 amp. arcs on rectifiers	All.....	7d. and 8d.	Brighton max. for 1 hr. daily	Thomson-Houston and Aron	1,100 kw	Lanarkshire dross (soft Scotch)	£61,
	2 Westinghouse 6-pole, 4 Ferranti disc armature	2 100 kw. dynamos, 2 100 kw., 2 200 kw.	Direct coupled	Condensing, sea water and ejector condenser	H.T. rdrs. ld. con., L.P. trpl. con. ld. cv., twin l.c. ar. & sgl. do.	24 arcs, abt. 12,000 8 c.p.	74 arcs, 4 incandescent	All.....	4½d.	No discts. or sliding scale	Shallenberger....	600 kw.	Welsh steam coal	£56,
turbo p., 600	Ferranti, Parsons and Richardson	3 212 kw., 1 150 kw., 2,600 kw.	Direct ..	Condensing....	Con., Jennings conduits, and B.I.W. concen.	24 arcs, 71,000 8 c.p.	264 arcs, 470 32 c.p., & 16 16 c.p.	—	4½d. lighting, 2½d. power	—	Shallenberger, Thomson, and Hookham	1,986 kw.	Small bituminous	
h.p., 2 (Brow-	Ferranti, Mordey and Johnson and Phillips	2 54 kw., 1 25 kw. and 2 120 kw.	3 by ropes and 2 dir. coupled	Surface condensing	B.I.W. paper cbls., lead cov. & armd. also solid system	2 arcs and 4,257 incandesc'nt	23 arcs, 114 incand.	1,700....	5d. and 3d.	Sliding scale	Thomson-Houston and Shallenberger	373 kw.	Steam coal	
d com- Belliss)	Hall altrnatrs., E.C.C. dynamos	125 kw., 200 kw. ..	Direct ..	Condensing....	Concentric armd., single distrbutrs. for continuous	25,000 8 c.p.	—	9,000....	6d. to 4d. ltg., 3d. to 1½d. power	Discounts and time switch	Chambrln.-Hookm. Thomson-Houston, Westinghouse	775 kw.	Welsh steam coal	£50
o.) 150 es, 1 50	Johnson-Phillips alternators	2 100 kw., 1 35 kw...	Link belts	—	H.P. con. pr cov., ld. sh. & arm'd, L.P. con. l. sh., laid in gd.	4 arcs, equiv. of 4,500 8 c.p. lamps	270 32 c.p. incandsnt.	—	5½d., 5d. from 5 p.m. till 10 p.m., 2d. aft.	—	Chamberlain-Hookham	235 kw.	Anthracite	
5 h.p.	Brush, Nalder and Harrison	1 50 kw., 1 35 kw. ..	Belts....	Non-condensing	Concentric, lead covered	2 arcs, equv. of 3,900 8 c.p.	—	350	5d. and 4d., plus a fixed charge	Meter ..	Shallenberger, Chamberlain-Hookham & Aron	85 kw.	Coal and coke	
ensing,	Johnson & Phillips revolving fields, embedded armature coils	1 125 kw., 1 25 kw.	Direct ..	—	Concentric and paper	34 arcs, 5,750 8 c.p.	4 arcs	1,724....	6d. light, 4d. power and heat	Meter, no discount	Thomson-Houston, Chamberlain-Hookham & Aron	150 kw.	Slack	£13
00 h.p.	Mather and Platt	3 120 kw.....	Ropes ..	Condensing....	Paper cables and fibrous, arm'rd & drawn in system	48,000	2 arcs	8,000....	6d. 1st hr., 2d. after; pwr. 3½d. 1st hr., 1d. afr.	Sliding scale	Shallenberger, Thomson-Houston and Hookham	360 kw. & 225 kw. batteries	Gas coke ..	£95
0 kw.,	Parsons	4 150 kw., 1 75 kw.	Direct ..	Jet and surface	H.T. Silvertn. cbls. in c.i. pipes and B.I.W. con. for L.T.	27,171 8 c.p., includes 308 for motors	—	4,671....	6½d. to 5½d., ovr. £75 7d. 1st hr., then 3d.	Discounts	Hookham, Shallenberger, Thomson-Houston	675 kw.	Steam coal and coke breeze	£23
pansion	Ferranti and Brush	2 600 kw., 3 300 kw., 1 125 kw., 1 100 kw.	Direct ..	Condensing....	Paper cables and bitumen conduit	99,570 8 c.p.	—	25,717 ..	4d.	Uniform charge of 4d.	Thomson-Houston Shallenberger, Aron, & Hookham	2,325 kw.	Hard slack	£136
lo. 500	Ferranti	2 125 kw., 1 300 kw., 1 600 kw.	Direct ..	Condensing....	H.T. & L.T. paper & jute, lead cov., arm'd concentric	42,378	43 arcs, 15 amp.	10,140 ..	6d., 4d., & 2d. for lighting 6d. & 2d. pwr.	Brighton	Shallenberger, Thomson-Houston, Hookham, & Aron	1,150 kw.	Slack	£45,
.....	Ferranti and Siemens.....	2 100 kw., 2 200 kw., 1 500 kw.	Direct ..	Condensing....	H.T. rub. concen., H.T. paper, L.T. paper and rub.	23,732 8 c.p.	65 arcs and 250 incandescent	11,482 ..	7d. and 2d., 2d. power	Brighton	Thomson-Houston and Chamberlain-Hookham	900 kw.	Unscreened coal	£80,
iss) 200 h.p., 1	Thomson-Houston	2 150 kw., 2 75 kw., 3 Ferranti rectifiers for arc lighting	Direct coupled	Condensing, jet condensers	Armoured concentric cables	21,500 8 c.p.	67 arcs, 250 incandsnt.	5,000....	6d. to 3½d.	Brighton	Thomson alone ..	450 kw.	Welsh smokeless coal	—
.....	Fynn inductor alternators ..	125 kw. each	Direct ..	Condensing....	Concentric H.T. feeders and L.T. distributors	9,956 8 c.p., 2 300 watt arcs	52 rect. 600 watt arcs, 103 32 c.p. incan.	3,456....	7d. first hour, 3d. after	Wright's	Aron, Thomson, and Chamberln.-Hookham	375 kw.	Coal	£24,
.....	Johnson and Phillips and Ferranti	1 400 kw., 3 80 kw., 1 40 kw.	Direct ..	Condensing....	Armoured concentric cables	32,000 8 c.p.	60 arcs, 300 incandescents	9,000 ..	6d. and 3d., power 3d.	Demand system on 1 hr. basis	Aron, Westnghse., Chambrln.-Hookm. & Thoms'n-Houst'n	680 kw.	Welsh coal (raily. rate 11/10 ton)	£42,
Belliss)	Fowler.....	3 112 kw., 1 28 kw.	Direct ..	Condensing, jet	Armoured concentric, triple and 3 core	14,000	16 arcs	3,900....	6d. first hour, 3d. after	Brighton	Westinghouse and Thomson-Houston	390 kw.	Smudge coal	£29,
h.p., 1 y) and	Ferranti	2 75 kw., 1 200 kw., and 1 300 kw.	Direct ..	Condensing....	B.I.W. armoured cable	14,041 8 c.p.	19 arcs	5,398....	6d. to 4d., on free wiring sys. 7d. to 5d.	Sliding scale	Westinghouse and Chamberlain-Hookham	650 kw.	Coke.....	£25, to 31/3
50 h.p.,	Mordey inductor alternators	2 150 kw., 1 30 kw...	Direct coupled	Non-condensing	Henley.....	Equivalt. of 6,300 8 c.p.	Equivalt. of 2,000 8 c.p.	—	6d.	8d. & 3d., Wright's mx. dmd.	Chamberlain-Hookham	330 kw. (without reserve)	Nottingham steam coal	—
00 h.p.	Ferranti	3 200 kw., 1 100 kw., 2 1,200 kw. erecting	Direct ..	Condensing....	B.I.W. con. ld. cov. arm. ld. dir., B.I.W. con. ld. cov. in pipes	20,794	88 enclosed arcs, 42 8 c.p. incand.	3,794 ..	7d. one hour and 3d. after, pwr. 5d. & 2d.	Wright's	Thomson-Houston and Chamberlain-Hookham	700 kw.	North Country small coal	Abou £50
ns) 125	Parsons and Brush	2 75 kw., 2 37½ kw.,	Belt and direct	Surface condensing	Vulcanised rubber cables	5 arcs, &c.	130 incandescents	1,800....	8d.	Discounts on quantity used	Shallenberger and Thomson-Houston	225 kw.	Welsh coal	—
s), 1 48 00 h.p.	Mordey and Ferranti	4 125 kw., 1 400 kw.	Ropes and direct	Condensing....	Brooks semi-solid B.I.W. or Callender's	28 arcs and 31,000 8 c.p.	56 arcs and 15 incandescent	3,800 (approx.)	6d. and 2½d...	Brighton	Hookham, Thomson-Houston	900 kw.	Large Welsh	£74, (appr
h.p. ..	Crompton	2 150 kw., 3 75 kw., 1 15 kw., 4 15 kw. (arc lighters)	Direct and rope	Surface condensers	Concentric, paper	19,500 8 c.p.	75 arcs	4,500....	6d. lighting, 3½d. power	—	Shallenberger, Thomson, and Hookham	600 kw.	Coal and gas coke	—
, Allis, Browett-	Mordey, Ferranti, British Thomson-Houston, Westinghouse	400 kw. to 1,800 kw.	Direct ..	Condensing....	Concentric cable.	430,000 8 c.p.	507 arcs, Markets 33 arcs	75,000 ..	4½d.	Sliding scale	Shlngr., Westghs., British Thomson-Houston, and Aron	—	Small coal and large Welsh	£712
Belliss) h.p.	5 Ferranti flywheel, 2 E.C.C. ironclad 300 kw.	1 25 kw., 3 125 kw., 3 300 kw.	Direct ..	Condensing....	Callender concen. in c.i. pipes	24,700	150	—	6d. one hour, 3d. after	Brighton and Manchstr.	Chamberlain-Hookham	1,300 kw.	Welsh coal	£85,
145 h.p., , 3 do. h.p., 2 ss) 80 h.p	Siemens and Ferranti	2 200 kw., 2 100 kw., 3 18 kw., 3 13 kw., 4 350 kw., 1 50 kw.	Direct ..	Non-condensing	Siemens, Glover, and B.I.W. paper, Siemens 3 core	100,451 8 c.p.	58 arcs	22,360 ..	6d. and 2½d.	Brighton	Thomson, Shallenberger, and Aron	2,243 kw.	Welsh coal	To
600 i.h.p., 000 h.p.	Ferranti, Fowler & Crompton	4 125 kw., 1 40 kw., 3 300 kw. and 3 600 kw. in progress	Direct and ropes	Non-condensing	Rubber concentric, steel armoured	32,000 8 c.p. (approx.)	330 arcs, no incandsnt.	8,268....	7d. to 4d., power & day supply 3½d.	Modified Brighton	Chmbrlin.-Hookm., Westnhs., T.-Hous., Aron (in progress)	1,460 kw.	Welsh coal	£230 (appr gross
250 h.p.,	E.C.C.	1 350 kw., 5 200 kw., 2 150 kw., 2 80 kw.	Direct ..	1,000 h.p. condensing	Paper cables	95,303 8 c.p.	7 arcs, 14 incandescent (trial)	15,002 ..	6d., with special discts.	—	Westinghouse, Thomson-Houston and Aron	1,810 kw.	Anthracite, &c.	—
Parsons,	Kapp, Johnson-Phillips, Siemens, Latimer Clark, Parker, Parsons and Westinghouse	120 to 1,500 kw.	Direct and ropes	Both.....	Paper and rubber cables	500,000 8 c.p.	20 arcs	67,000 ..	6d.	Sliding scale	Thomson-Houston, Shallenberger, and Aron	—	Welsh coal	—
Plenty &	Ferranti	—	Ropes and direct	Condensing....	Paper and jute ..	—	—	—	6d. p. unit with sliding scale, also demand indicator	Meter registration	Various	—	Welsh steam coal	—
lo. 1,500 0 h.p. (1)	3 Ferranti, 1 British Thomson-Houston	2 250 kw., 1 1,000 kw., 1 500 kw.	Direct ..	Non-condensing	H.T. fdr. netwk sup. plyg. L.T. distrs thro' trans. in st.	26,000 8 c.p.	—	1,300....	6d.	—	Shallenberger and Thoms'n-Houst'n	2,000 kw.	Coal refuse	£200
250 h.p.,	5 Mordey, 6 E.C.C., and 2 B.T.H. multipolar	150 kw., 525 kw. ..	Direct ..	Condensing....	H.T. paper con. power cbls., rubber conc. & arm'd, in c.i. pipes	49,711	—	17,252 ..	7d. 1st 1½ hrs'. ltg. then 3d., 4d. first hr., then 2d. pwr.	Brighton	Thomson-Houston	2,700 kw.	Small rough coal	—
h.p.	Mordey	150 kw. each	Direct ..	Condensing....	H.T. arm'rd, con. rub. L.T. lead cov. bitumenised fibre	47,150	—	18,524 ..	7d. 1st 1½ hrs.' ltg. then 3d., 6d. 1st hr's. pwr. then 3d.	Brighton	Thomson-Houston	900 kw.	Small rough coal	—

ARD,

Telegrams: "Rickard."

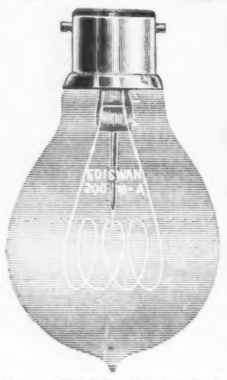
S,

CORDS,

iption.

& DISCOUNTS.

EDISWAN



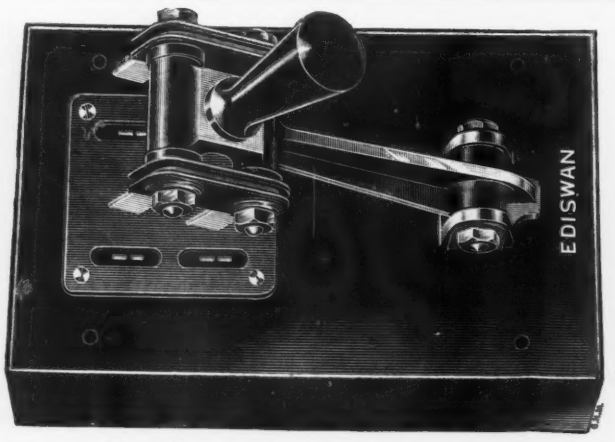
16 c.p. HIGH VOLTAGE LAMP, 200 volts. (HALF SIZE.)

HIGH-TENSION FITTINGS.

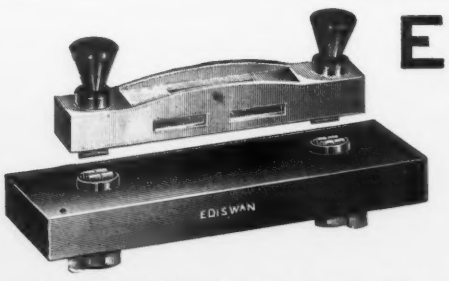
ALTERNATORS.

TRANSFORMERS.

ALTERNATING CURRENT BOOSTERS.



2,000 VOLT SWITCHES UP TO 200 AMPERES.



2,000 VOLT SWITCH FUSE UP TO 200 AMPERES.

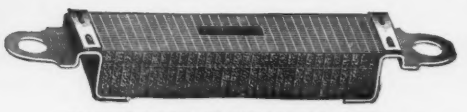


ILLUSTRATION OF REFILL FOR ABOVE.

THE EDISON AND SWAN UNITED ELECTRIC LIGHT Co., Ltd., Head Offices, Warehouse and Showrooms, EDISWAN BUILDINGS, QUEEN STREET, LONDON,

EDIS

SWITCHBOA

SWITCHES.

CUT-OU

RESISTAN

FUSE-BOAR

CEILING-

ROS

kw.	Small steam	—	—	—	None	100	100 v. or 50 v.	—	—	D. Walker	Newcastle-on-Tyne (45)
kw	Abercarn small coal	£65,699	£18,260	5/8	None	87·5	100 v.	3 e.h.p.....	—	C. D. Copland	Newport.....(46)
kw	Lanarkshire dross (soft Scotch)	£61,000	£14,000	Not compltd.	2,000, all glow lamps	50	200 v.	6 b.h.p.....	Vicars stokers, Green economs., Pearn pumps	Francis Teague	Paisley .....(47)
kw.	Welsh steam coal	£56,000	£9,000	—	2,000.....	50	100 v. and 200 v.	12 = 25 h.p. and 2 = 1½ h.p.	Started Sept. 22/99. Tram and lightg. from same engns.	J. H. Rider....	Plymouth .....(48)
kw.	Small bituminous	£140,000		7/6	None	50	100 v.	50 h.p.	—	E. Price	Portsmouth ....(49)
kw.	Steam coal	£25,000		5/-	None	100	100 v.	3 = 4 h.p.	—	G. H. Nisbett (ch.) H. W. Sprunt (resident)	Prescot District (50)
kw.	Welsh steam coal	£50,000	£25,000	5/6	20,000	67	100 v. and 200 v.	12 = 97 b.h.p.	—	A. T. Cooper ..	Reading‡ .....(51)
kw.	Anthracite	£13,000		—	—	66	200 v.	3 = 9 h.p.	—	W. J. Ferguson	Redditch .....(52)
kw.	Coal and coke	£4,950		6/-	None	100	100 v.	None	—	W. H. Shears..	Rugby .....(53)
kw.	Slack	£13,500	£2,500	5/6	None	60	100 v.	—	—	J. S. Highfield	St. Helens† ....(54)
kw.& kw. eries	Gas coke ..	£95,000	£37,000	—	200 v., 36,000 8 c.p.	75	200 v. and 400 v.	About 200 h.p.	—	C. L. Turner ..	Salford .....(55)
kw.	Steam coal and coke breeze	£23,590	£20,350	4/7	609	80	100 v. and 200 v.	6 = 12½ h.p. ..	—	F. G. Holden ..	Scarborough ..(56)
5kw.	Hard slack	£136,600	£60,120	6/-	500	100	100 v. and 200 v.	15 h.p.....	—	W. Johnson ..	Sheffield.....(57)
0kw.	Slack	£45,215	£47,300	6/-	All outlying districts	50	100 v. and 210 v.	6 = 44½ h.p. ..	Large extensions, including electric tramways in hand	C. D. Taite....	Southport .....(58)
kw.	Unscreened coal	£80,000	£20,000	6/6	—	50	110 v. and 220 v.	1 2 h.p.....	—	J. A. Jeckell ..	South Shields ..(59)
kw.	Welsh smokeless coal	—	—	—	Extensions, 3,000	60	102½ v. and 205 v.	24 h.p.	Fxng. 33 kw. alt., 33 kw. con. cur. gener. coupl. dir. to 1 eng.	E. J. B. Thornhill	Taunton .....(60)
kw.	Coal	£24,969	£5,589	—	All.....	50	200 v.	None.....	Plant to be increased by 1 250 kw., 1 45 kw., 2 B. & W. blrs.	P. Storey.....	Torquay .....(61)
kw.	Welsh coal (raily. rate 11/10 ton)	£42,000	£11,500	5/2	All.....	67·5	220 v.	1 2 h.p.	Large extensions now being undertaken	H. L. P. Boot ..	Tunbridge Wells (62)
kw.	Smudge coal	£29,000	£6,500	5/1	Distbutn. entrly. on 200 v., 3 wire 400 v. acr. outer	60	200 v.	7 fan motors ..	Extension in hand £25,000	Robert Blackmore	Wakefield .....(63)
kw.	Coke.....	£25,838 to 31/3/'99	£6,170	—	None	50	100 v.	5 = 10 h.p.....	—	J. H. Crowther	Wallasey..... (64)
kw. nout rve)	Nottingham steam coal	—	—	—	—	—	200 v.	—	—	W. H. F. Colebrook	Watford .....(65)
kw.	North Country small coal	About £50,000	About £15,000	—	—	50	100 v.	4 = 18 h.p.	Extens. amounting to £51,000 in hand	J. K. Bock	West Ham.....(66)
kw.	Welsh coal	—	—	—	None	100	100 v.	None.....	—	A. J. Wheatley	Woking .....(67)
kw.	Large Welsh	£74,000 (approx.)	—	1897, 4/10¾	About 1,000 of 200 v.	100	100 v. and 200 v.	66 h.p.	—	E. E. Hoadley	Worcester.....(68)
kw.	Coal and gas coke	—	—	6/6	None	83·5	100 v.	About 16 h.p. ..	—	Gordon Bryant	Yarmouth .....(69)

LONDON.

-	Small coal and large Welsh	£712,887	£488,747	—	—	—	102 v. & 204 v., 200 v. & 400 v. con.	300 kw.	—	Frank Bailey ..	City* .....(70)
kw.	Welsh coal	£85,000	£30,000	10/10	None.....	50	110 v.	—	—	G. Gilbert Bell	Hammersmith ..(71)
kw.	Welsh coal	To March, '99 £51,768		6/4	None	90	105 v. and 100 v.	5 = 11 h.p. ..	—	G. H. Cottam..	Hampstead.... (72)
kw.	Welsh coal	£230,000 (approx.) gross total	£80,000 (approx.)	—	All extensions 200 v.	50	100 v. and 200 v.	—	—	Albert Gay	Islington .....(73)
kw.	Anthracite, &c.	—	—	—	None.....	83	100 v.	About half doz. on lighting circuits	—	H. W. Bowden	Kensington ....(74)
-	Welsh coal	—	—	—	Not many, but extending	—	50 v., 100 v., 200 v.	—	—	R. R. Todd....	London*.....(75)
-	Welsh steam coal	—	—	—	—	83	100 v.	—	—	G. W. Partridge	London .....(76)
kw.	Coal refuse	£200,000	£60,000	8/-	All.....	50	220 v.	—	—	Frederick A. Nixon	London .....(77)
kw.	Small rough coal	—	—	7/-	—	100 and 50	100 v.	84 = 382 h p ..	—	C. P. Sparks ..	St. Luke's and Clerkenwell* (78)
kw.	Small rough coal	—	—	7/-	All.....	100	200 v.	7 = 20 h.p. ..	—	C. P. Sparks ..	Wandsworth ..(79)

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